The Evolution of Convective Cloud Systems Determined by GOES-8 during CRYSTAL-FACE

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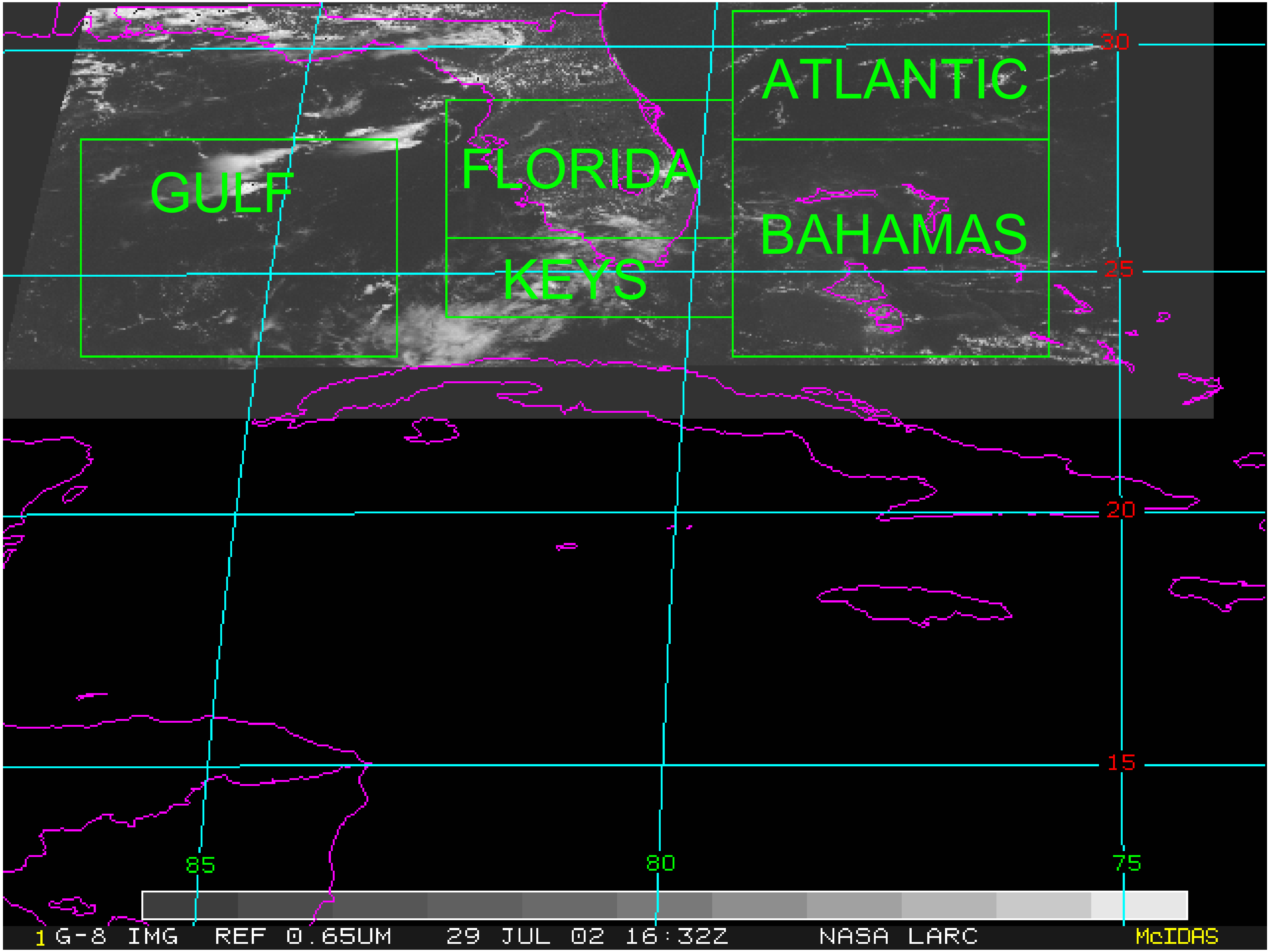
Objectives

- Better understanding of convective systems during CRYSTAL FACE from a satellite perspective
  - Determine convective system life time cycle and areal coverage statistics
  - Identify microphysical differences between land and ocean systems
  - Identify the impact of precipitation on convective systems
  - Gather convective system characteristic statistics
    - Convective diameter
    - Tracking and length of anvil
- Provide statistics for accurate modeling of systems
  - Identify the factors that determine anvil and cirrus generation and their dissipation

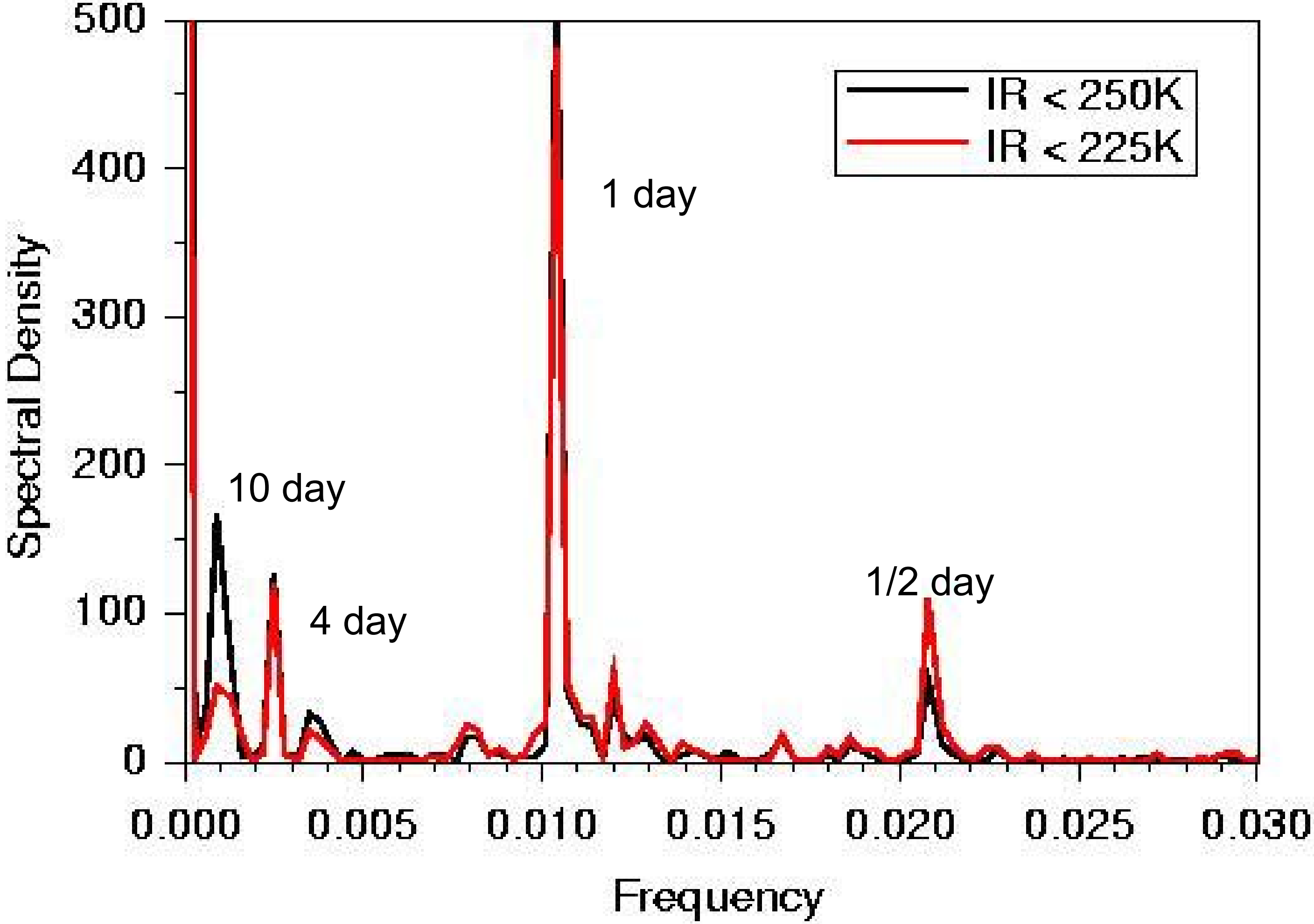
IR Fourier Analysis

- Divide domain into 5 regions
- Compute Fractional Areas for two categories from GOES-8 IR images
  - Area fraction of convection
    - IR<225°K = Pixels < 225°K /total pixels
  - Area fraction of convection & anvil
    - IR<250°K = Pixels < 250°K /total pixels
  - 15 minute resolution
  - 4 km pixel resolution
  - June 29-July 31, 2002
- Perform fourier analysis to identify the major life time cycles of convection



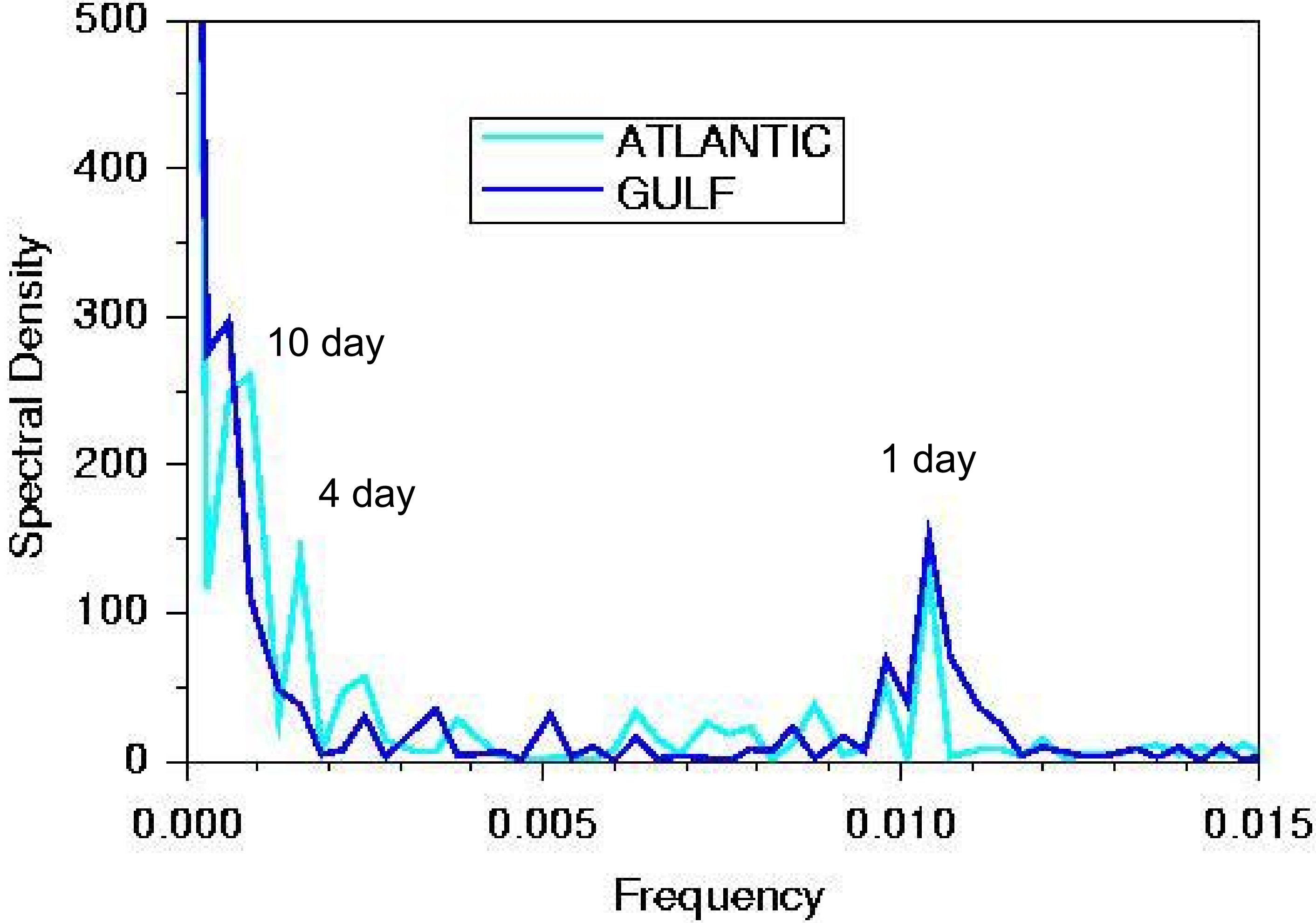
ATLANTIC
FLORIDA
GULF
BAHAMAS
KEYS
30
25
20
15
85
80
75
1 G-8 IMG REF 0.65UM 29 JUL 02 16:32Z NASA LARC
McIDAS

FLORIDA



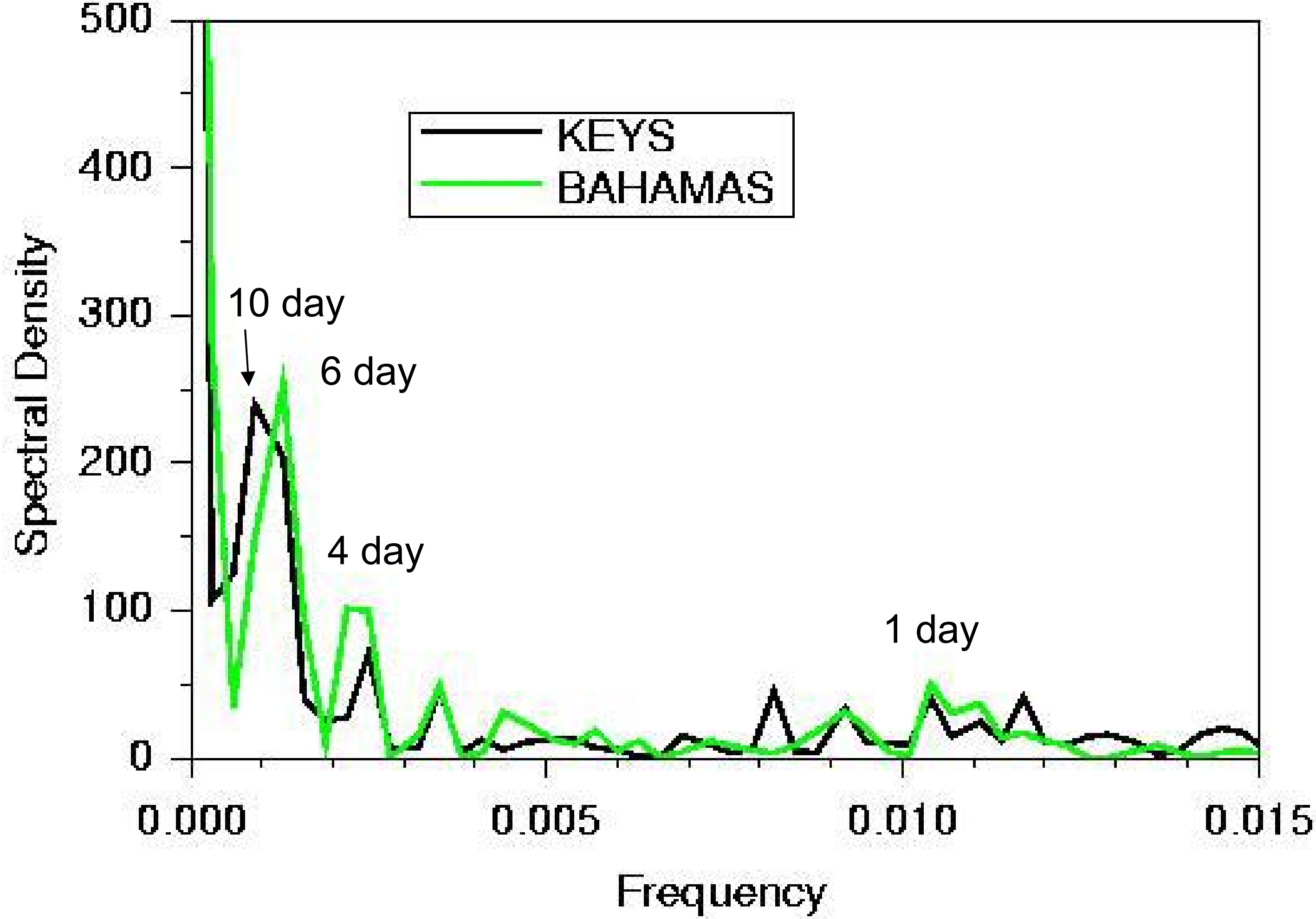
IR < 250K
IR < 225K
1 day
10 day
4 day
1/2 day
Spectral Density
500
400
300
200
100
0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
Frequency

IR < 250°K



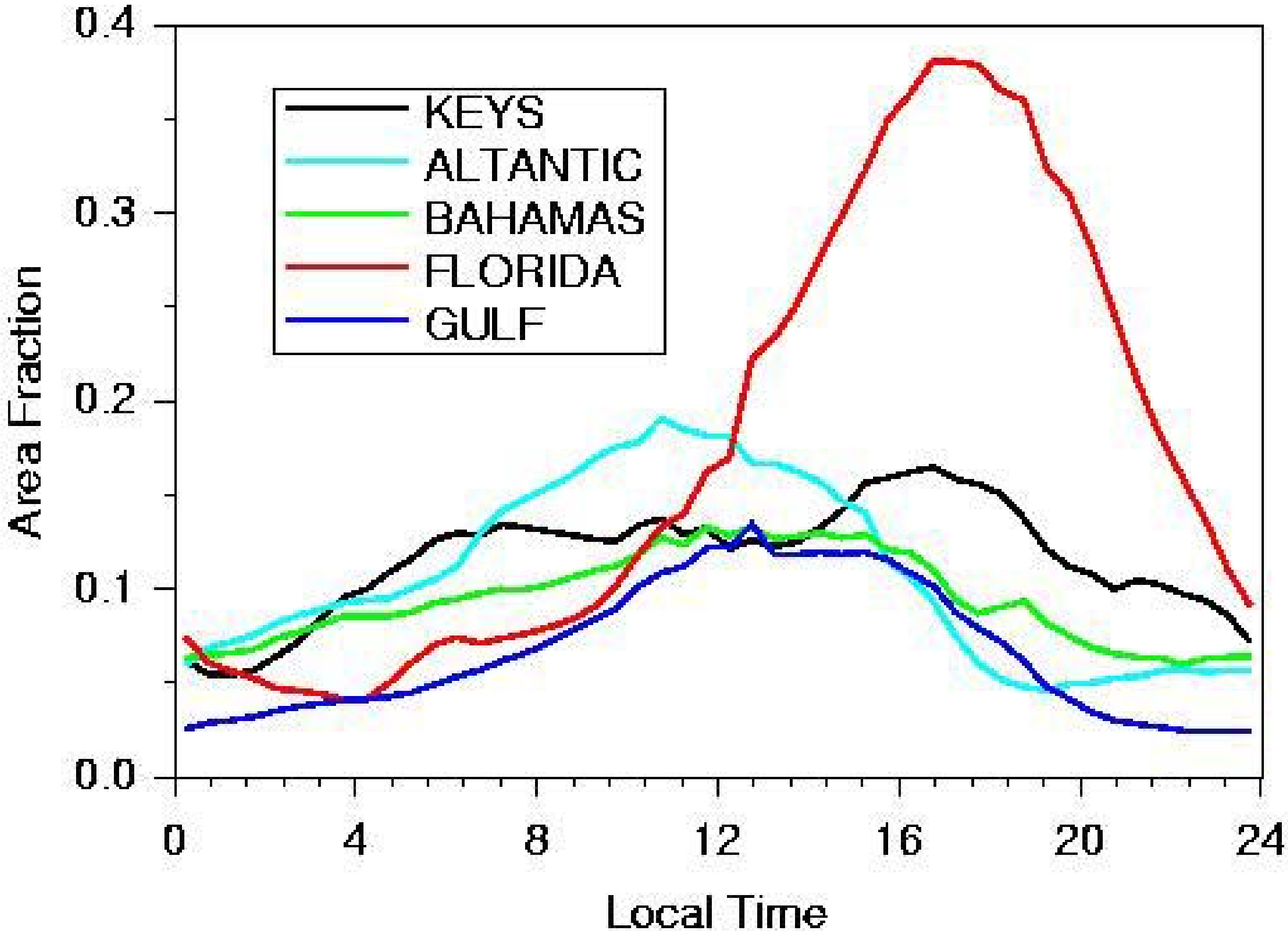
ATLANTIC
GULF
10 day
4 day
1 day
Spectral Density
Frequency
500
400
300
200
100
0
0.000
0.005
0.010
0.015

IR < 250°K

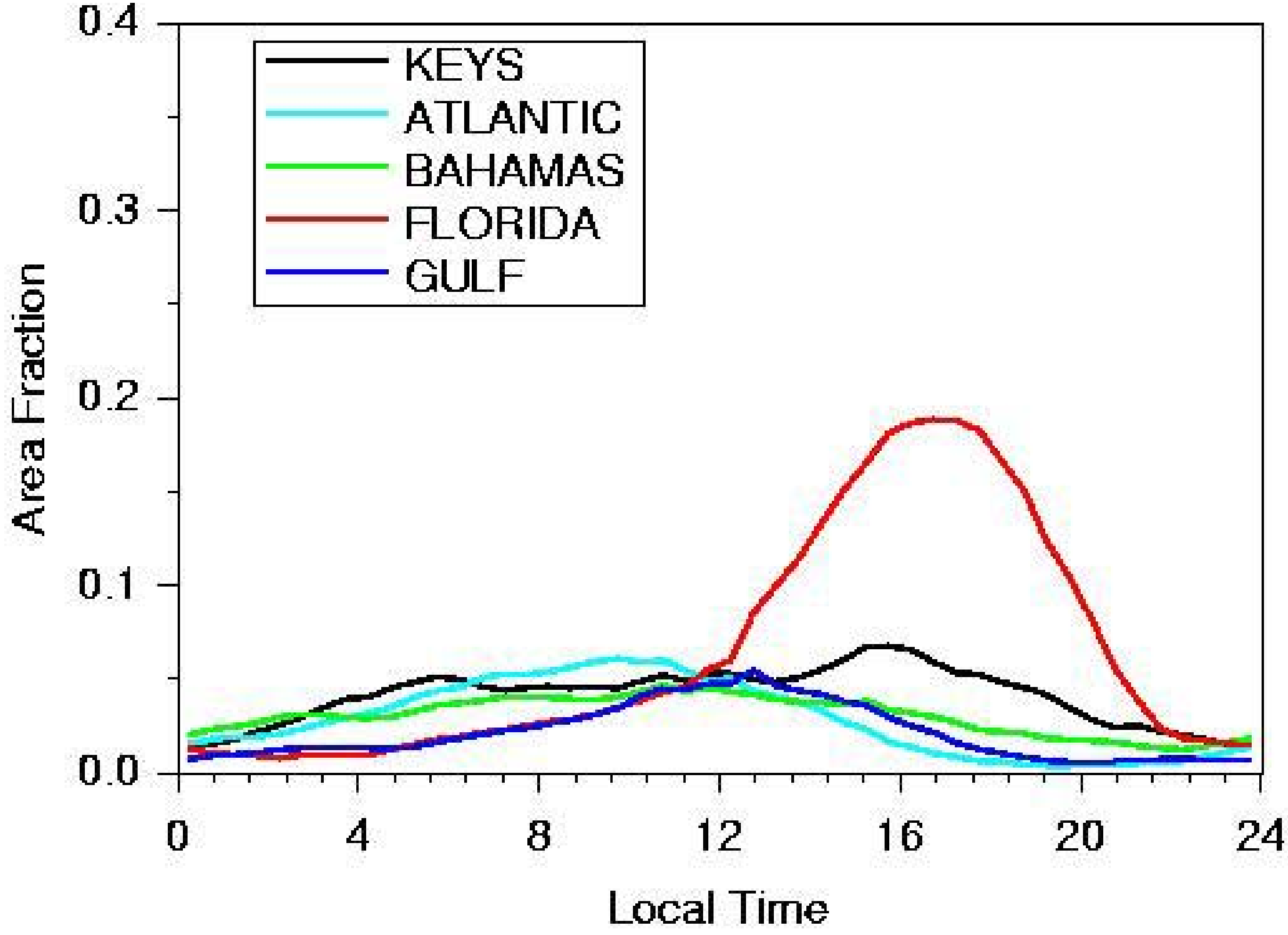


500
400
300
200
100
0
Spectral Density
KEYS
BAHAMAS
10 day
6 day
4 day
1 day
0.000
0.005
0.010
0.015
Frequency

AREA COVERAGE FOR IR<250°K



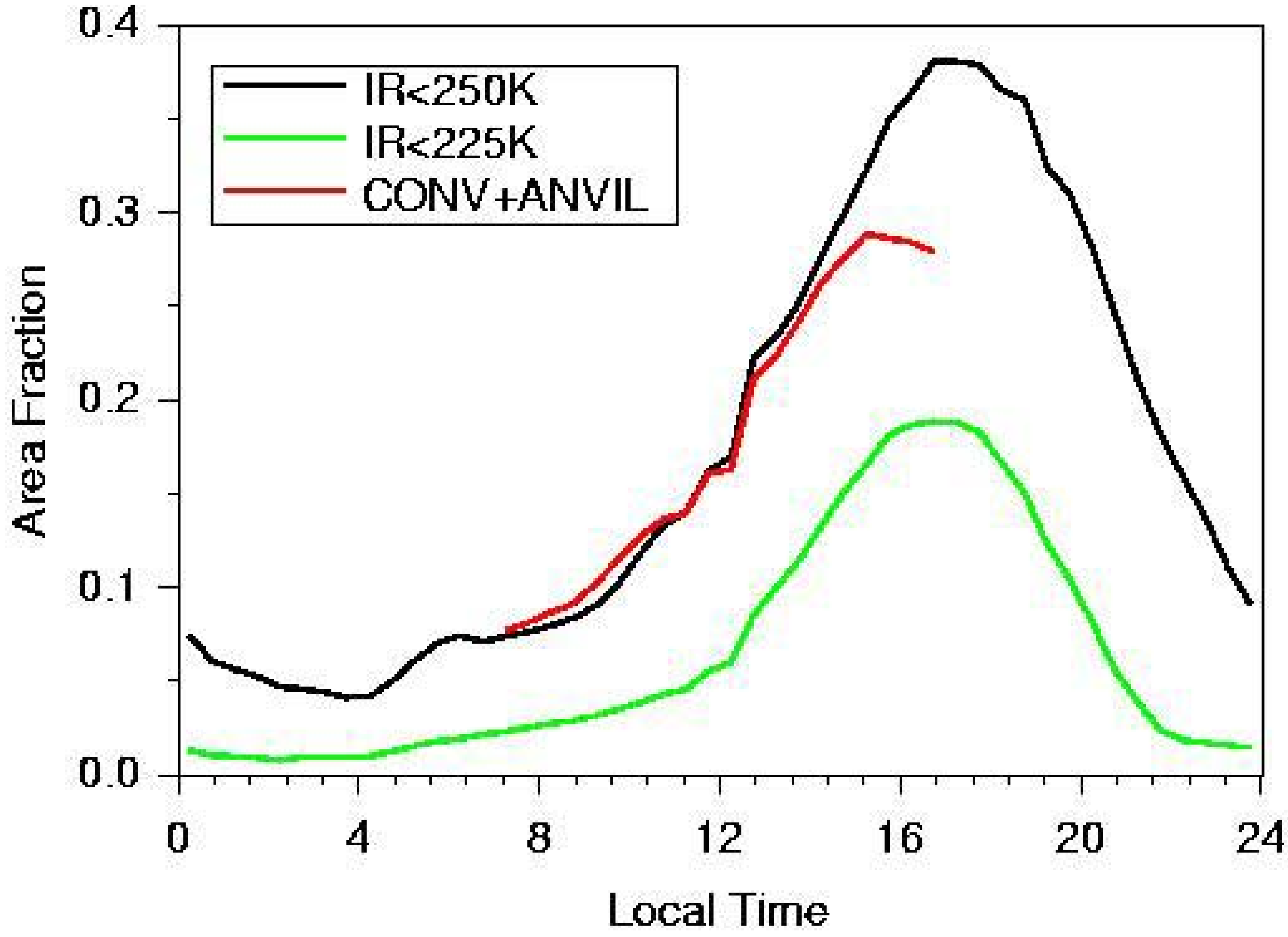
AREA COVERAGE FOR IR<225°K



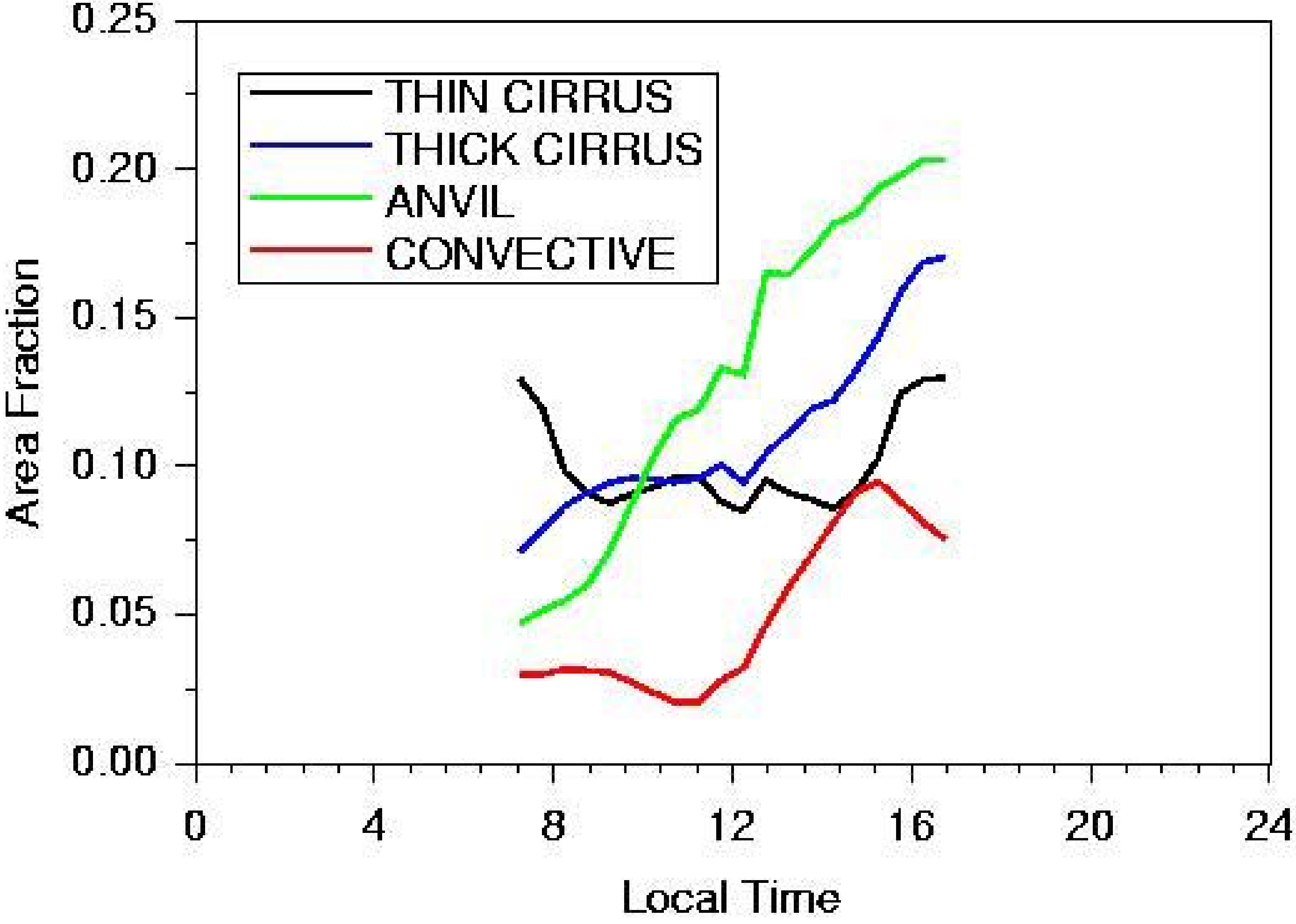
GOES-8 VISST Ice Cloud Coverage

- Use NASA-Langley GOES-8 VISST daytime products
  - 12:30-23:30 GMT images were the solar zenith angles < 70°
- Divide ice cloud pixels into 4 categories and compute area fractions for
  - Convective (optical depth > 64)
  - Anvil (8 < optical depth < 64)
  - Thick Cirrus (2 < optical depth < 8)
  - Thin Cirrus(0 < optical depth < 2)
- Compare cloud categories regionally and diurnally

FLORIDA

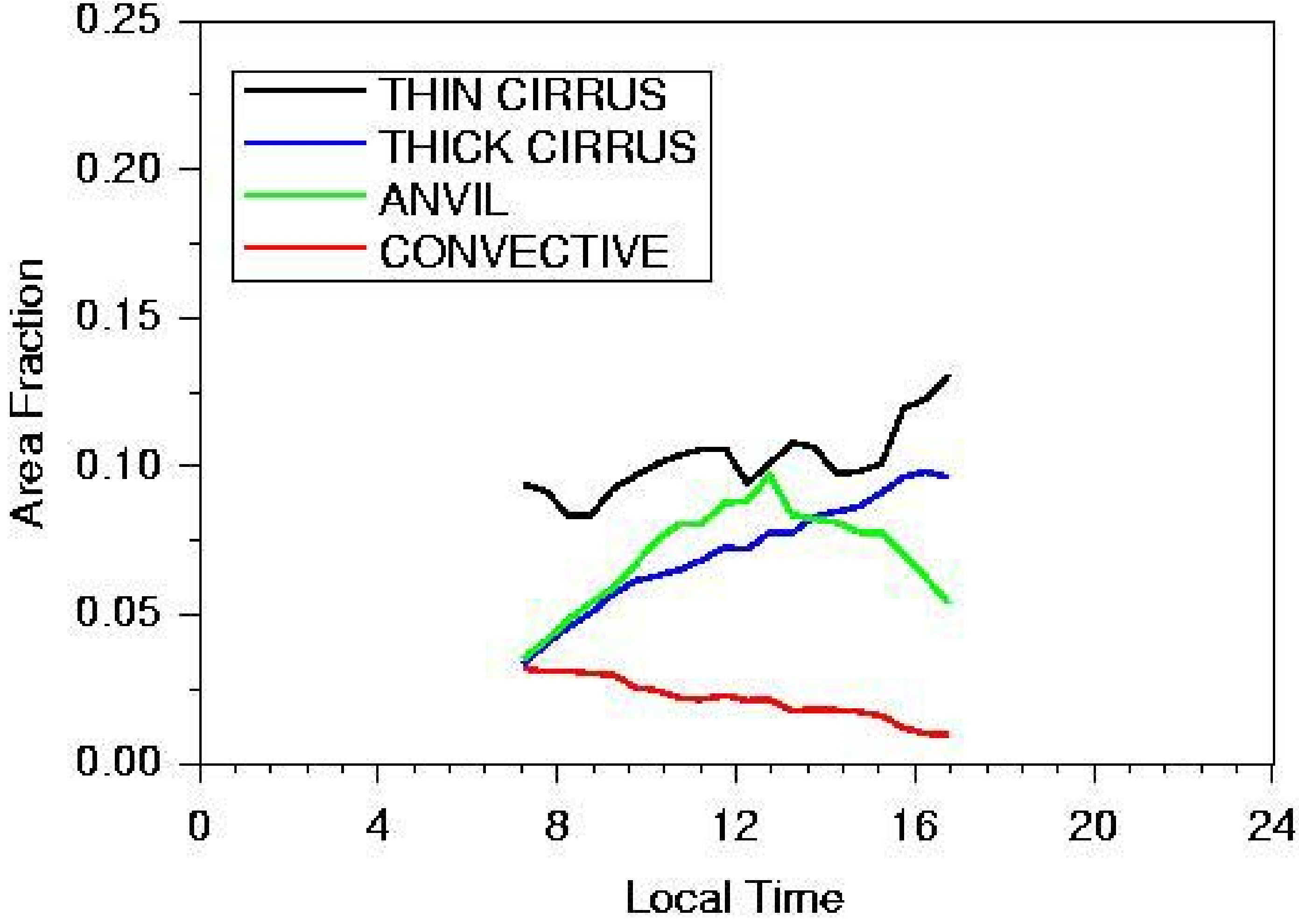

IR<250K
IR<225K
CONV+ANVIL
0.4
0.3
0.2
0.1
0.0
Area Fraction
0
4
8
12
16
20
24
Local Time

FLORIDA



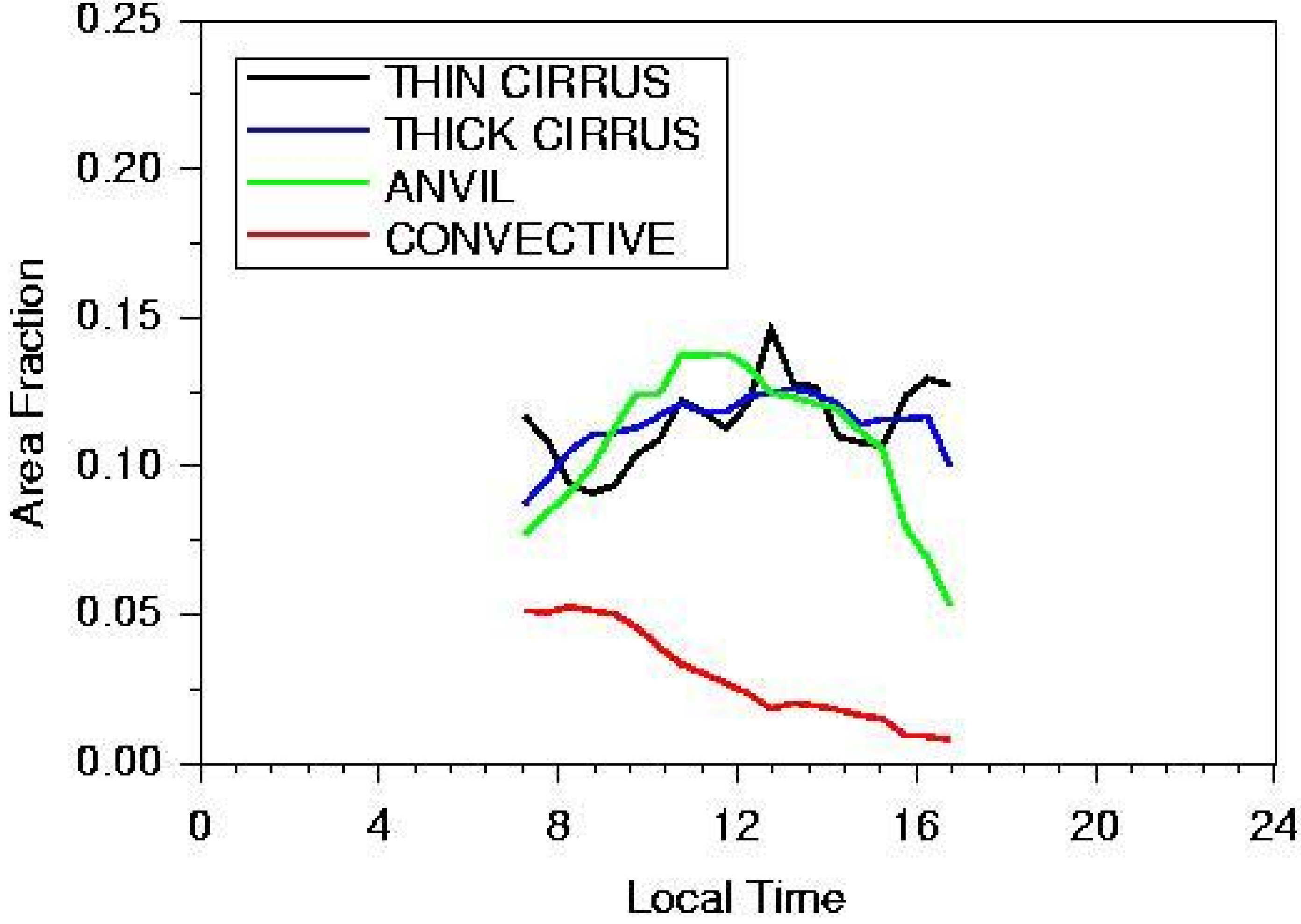
0.25
0.20
0.15
0.10
0.05
0.00
Area Fraction
THIN CIRRUS
THICK CIRRUS
ANVIL
CONVECTIVE
0
4
8
12
16
20
24
Local Time

GULF

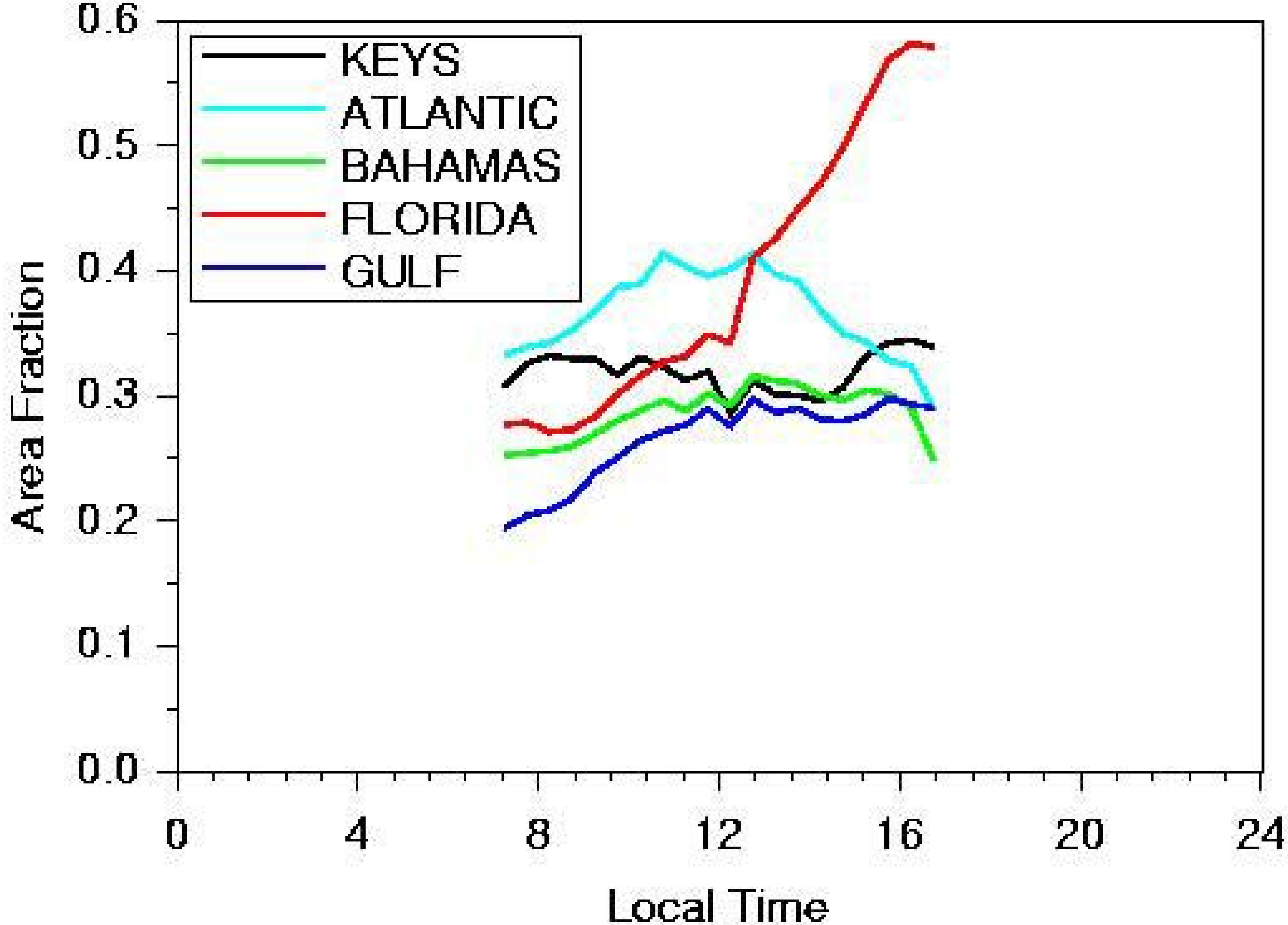


THIN CIRRUS
THICK CIRRUS
ANVIL
CONVECTIVE
Area Fraction
0.25
0.20
0.15
0.10
0.05
0.00
0
4
8
12
16
20
24
Local Time

ATLANTIC

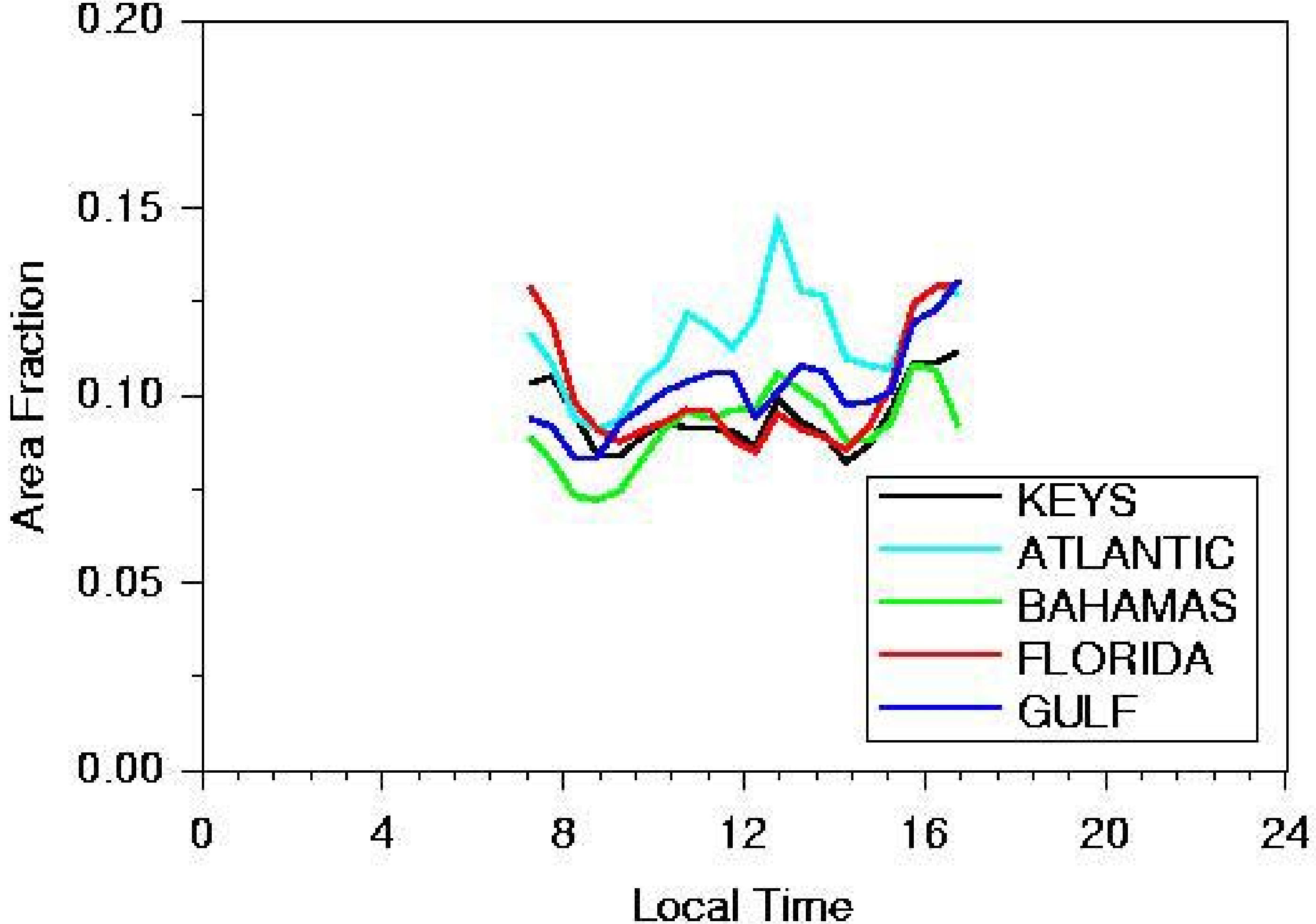

0.25
0.20
0.15
0.10
0.05
0.00
Area Fraction
THIN CIRRUS
THICK CIRRUS
ANVIL
CONVECTIVE
0
4
8
12
16
20
24
Local Time

TOTAL ICE



KEYS
ATLANTIC
BAHAMAS
FLORIDA
GULF
Area Fraction
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
4
8
12
16
20
24
Local Time

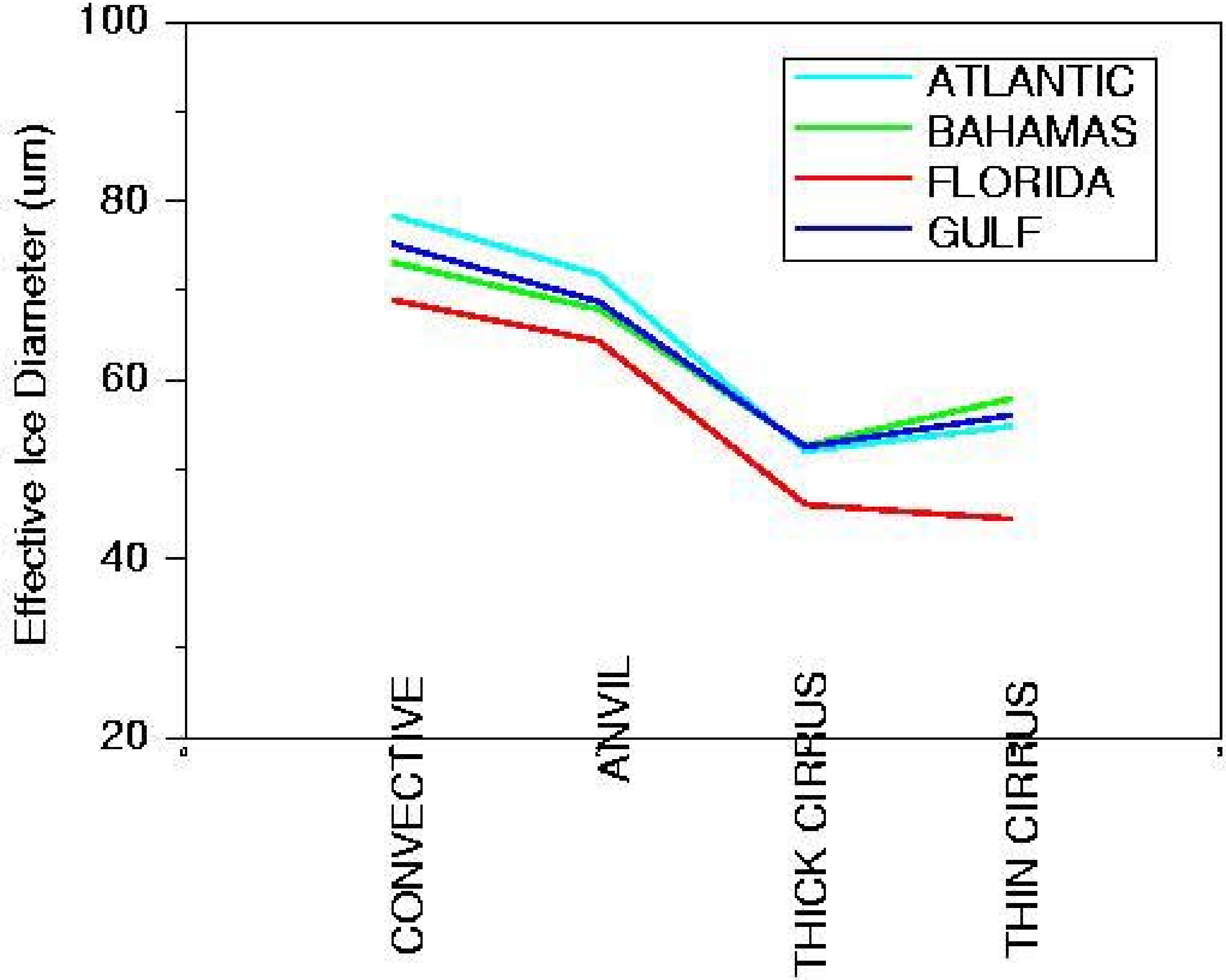
THIN CIRRUS


0.20
0.15
0.10
0.05
0.00
Area Fraction
0
4
8
12
16
20
24
Local Time
KEYS
ATLANTIC
BAHAMAS
FLORIDA
GULF

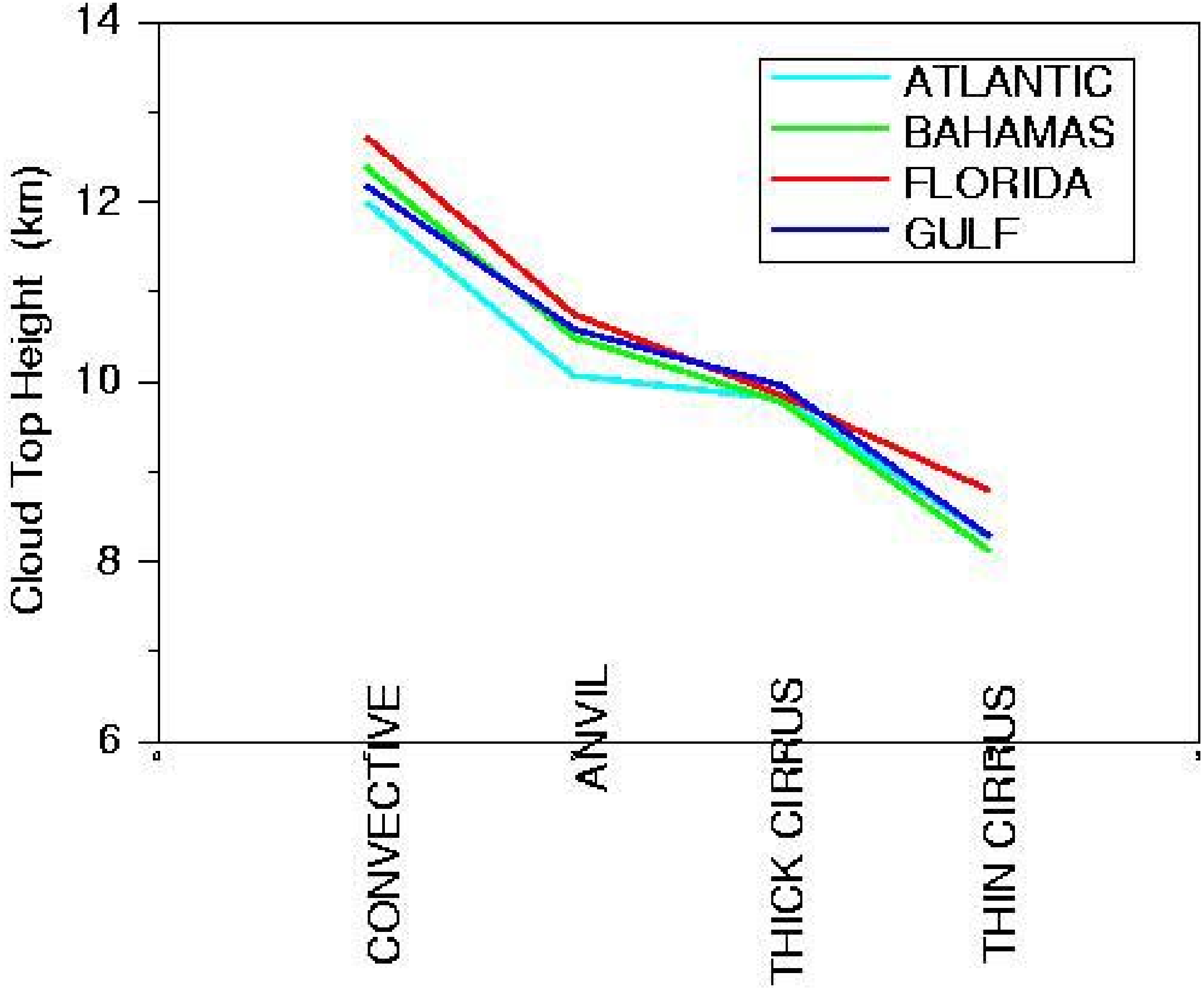
Compare Microphysical Properties

- Compute the mean microphysical cloud properties for each of the 4 ice cloud categories
- Determine monthly regional and category differences of
  - Effective ice particles size
  - Ice water path
  - Cloud top height
  - Make sure all 8 surrounding pixels are of the same category to remove category boundary pixels from analysis.

PARTICLE SIZE

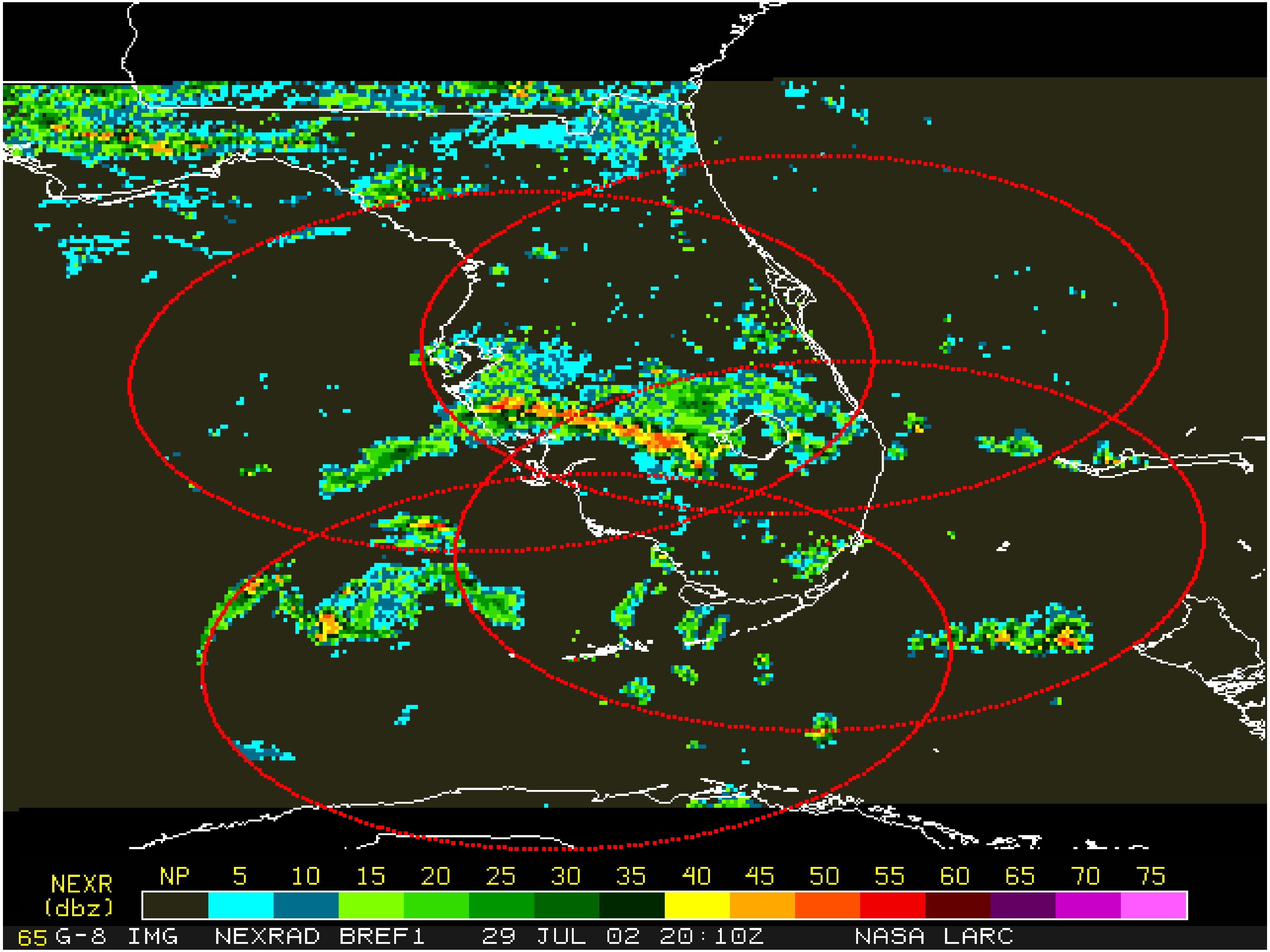


CLOUD TOP HEIGHT



The Impact Of Precipitation

- Map Nexrad radar reflectivities into GOES-8 projection
  - 6 station radar composite over Florida
  - Lowest tilt mode for maximum precipitation range
  - No effort made to clean radar clutter, sweep bands and clear air mode returns
- Compute mean microphysical properties for pixels with reflectivities > 30 dbz
- Compare precipitation properties with those computed from all pixels
  - Use only pixels that pass the surrounding pixel test


NEXR
(dbz)
NP 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
65 G-8 IMG NEXRAD BREF1 29 JUL 02 20:10Z NASA LARC

FLORIDA RAIN STATISTICS

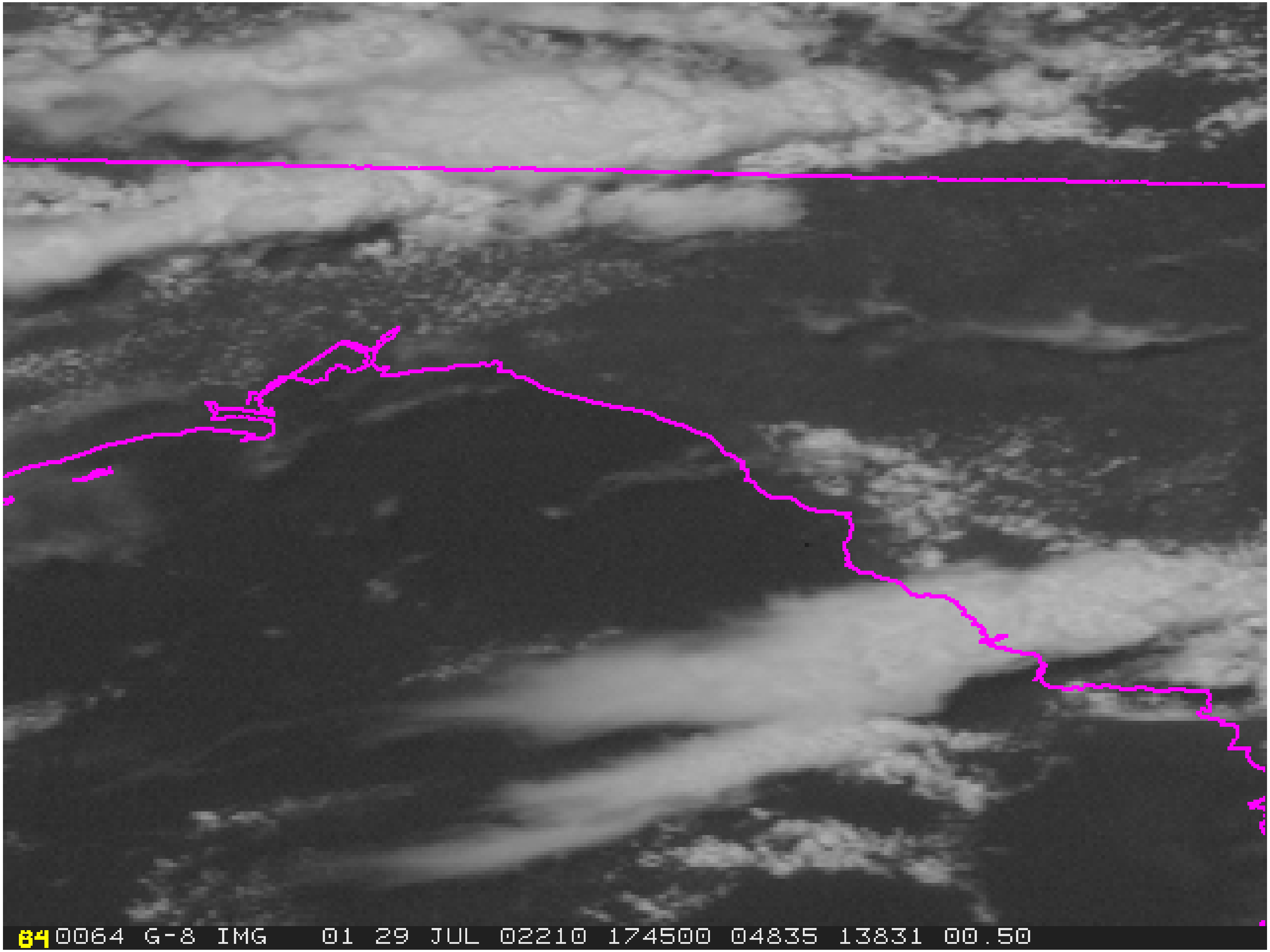
Deff (μm)	Florida	Rain
Convective	68.9	68.7
Anvil	64.3	60.7
Thin Cirrus	46.0	61.3

IWP (gm-2)	Florida	Rain
Convective	2440	2548
Anvil	503.5	586.1
Thin Cirrus	64.5	105.0

Rain Coverage (%)	
Convective	14.2
Anvil	4.0
Thin Cirrus	0.8

ANVIL TRACKING

- Visually inspect anvils
  - Use GOES-8 visible 1km 15 minute imagery (daytime, high resolution)
  - Use only isolated - discernable systems
  - Record diameter and location of convective cell
  - Record length and location of anvil
  - Record time when anvil dissipates
  - 121 cases analyzed
  - Hopefully find ways to automate tracking
- Show statistics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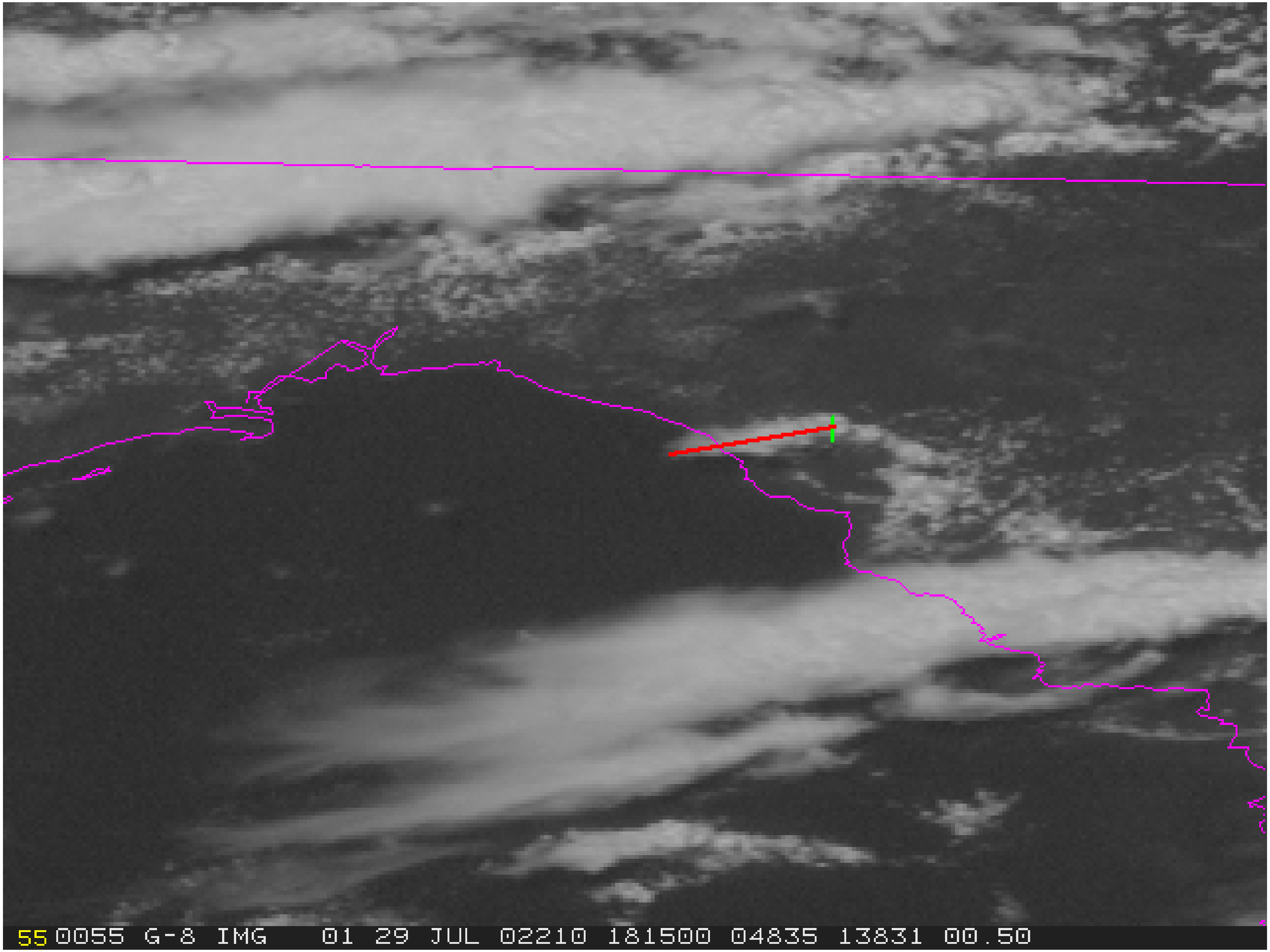
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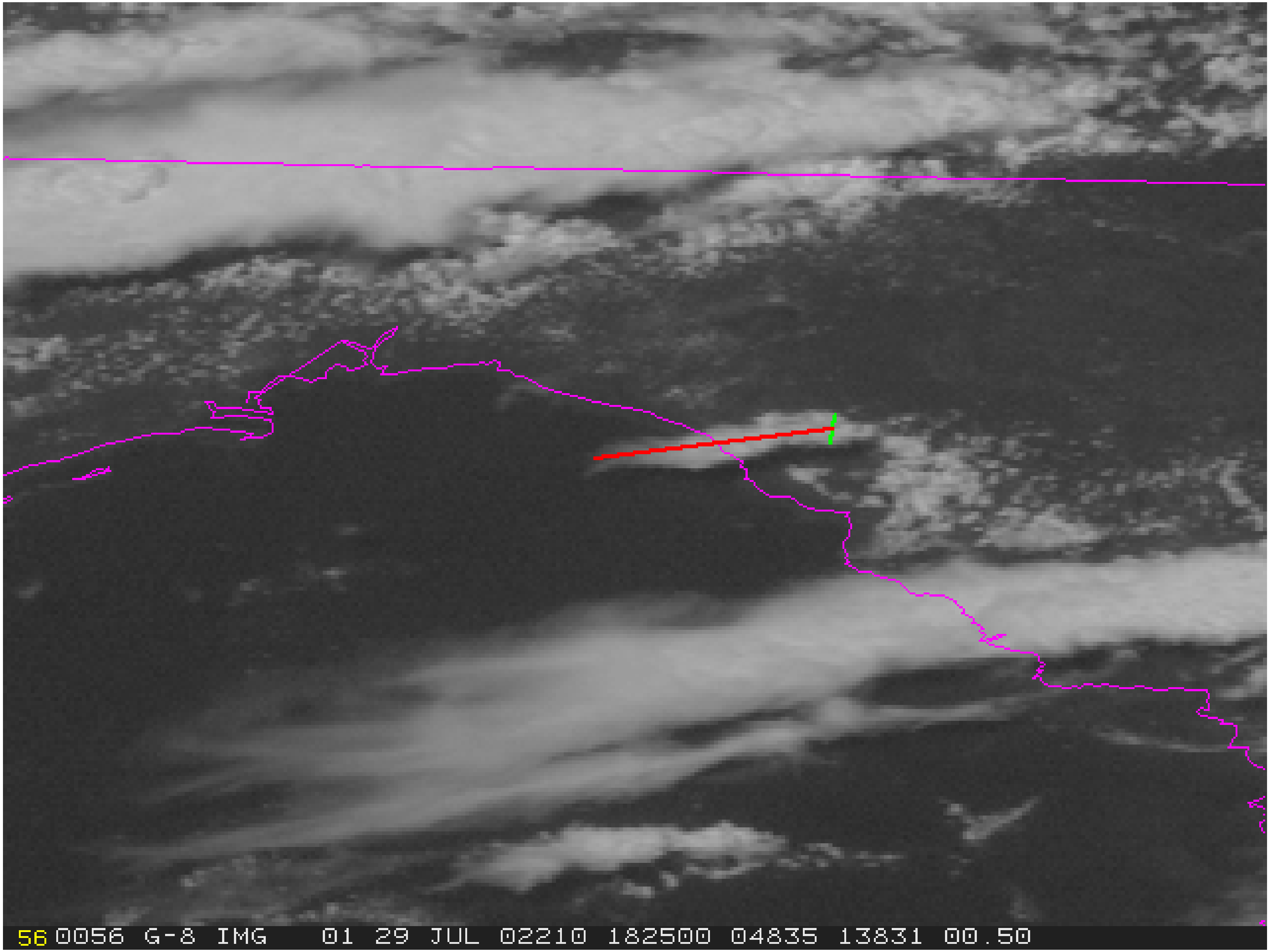
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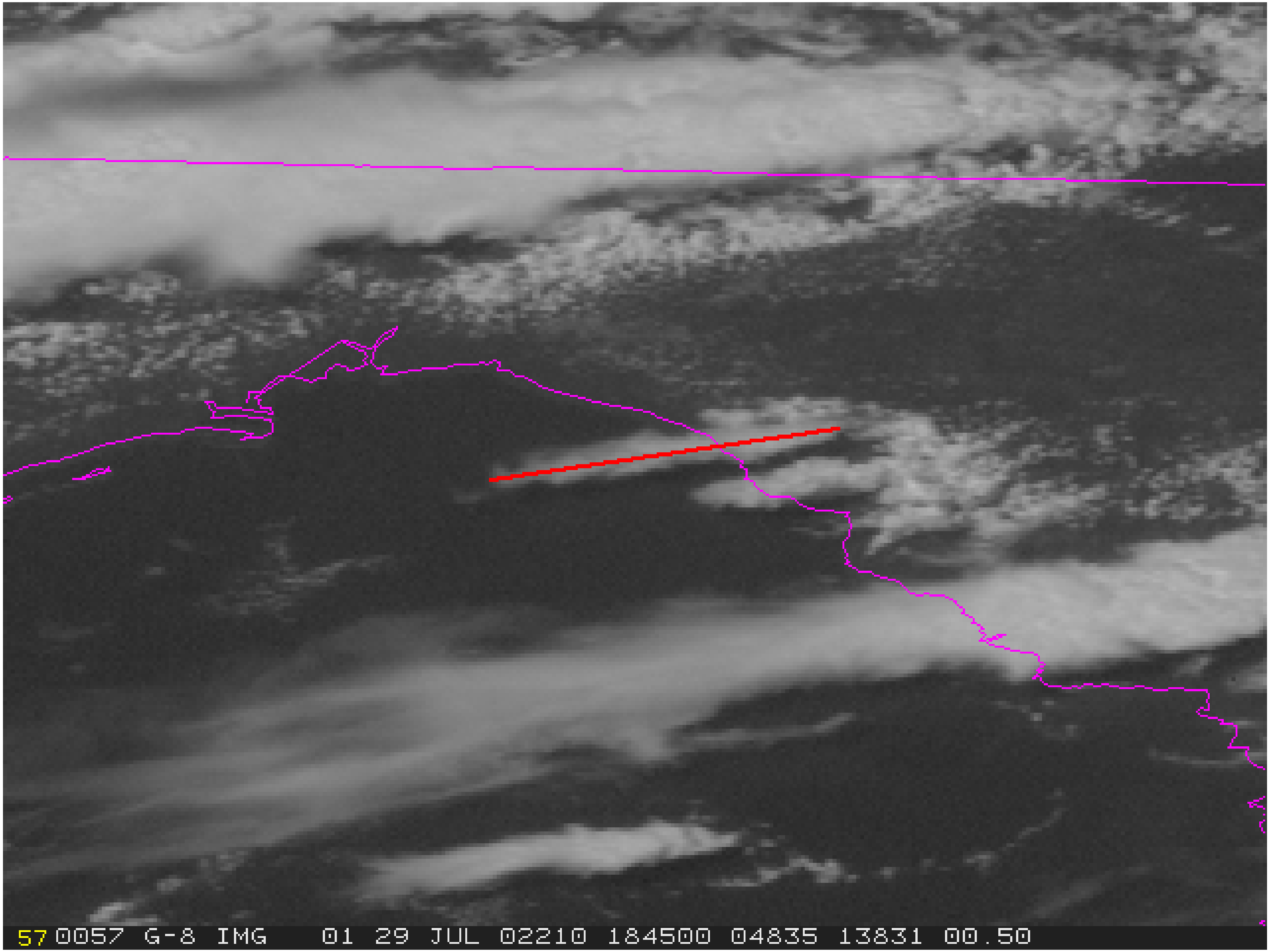
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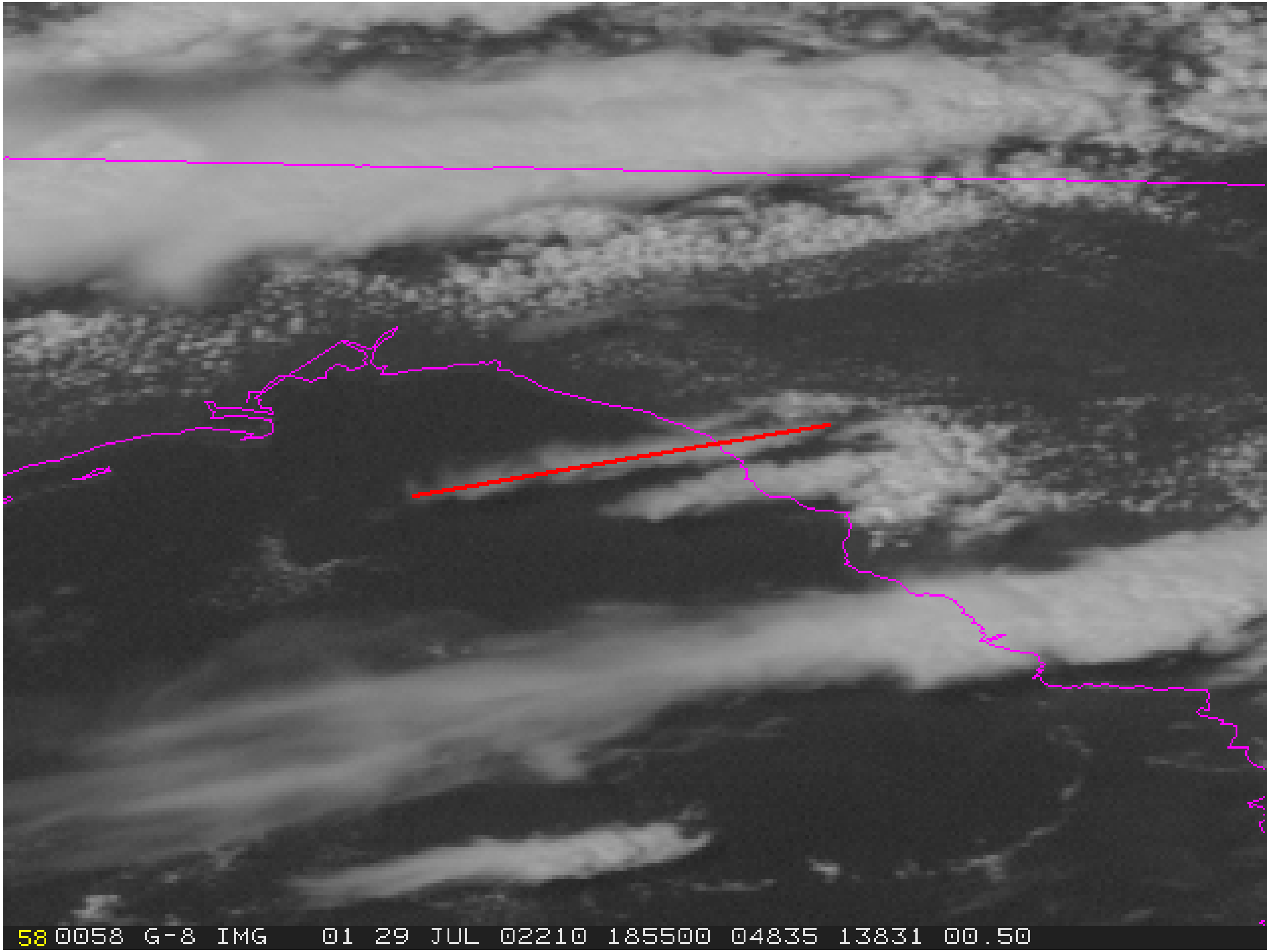
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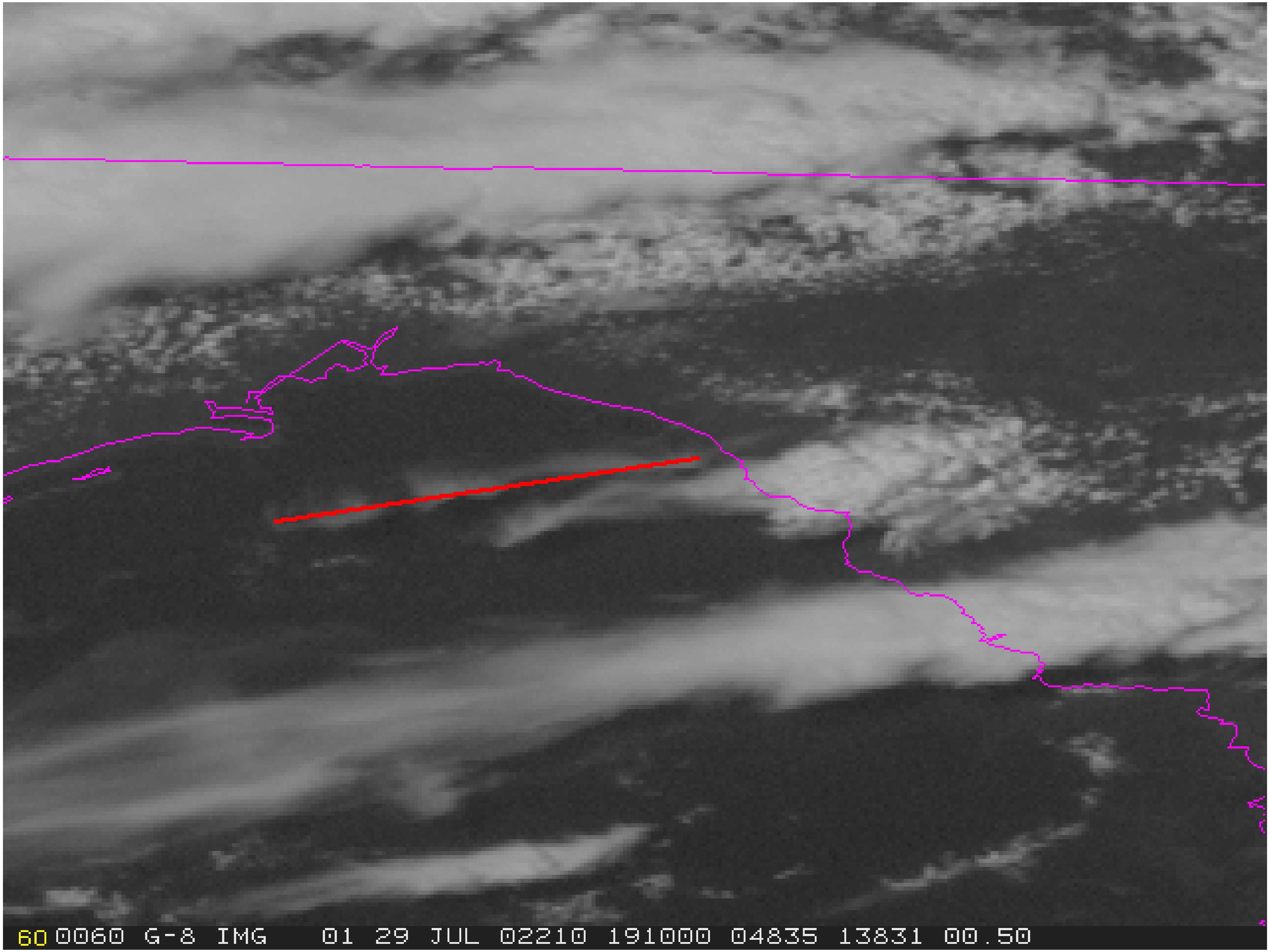
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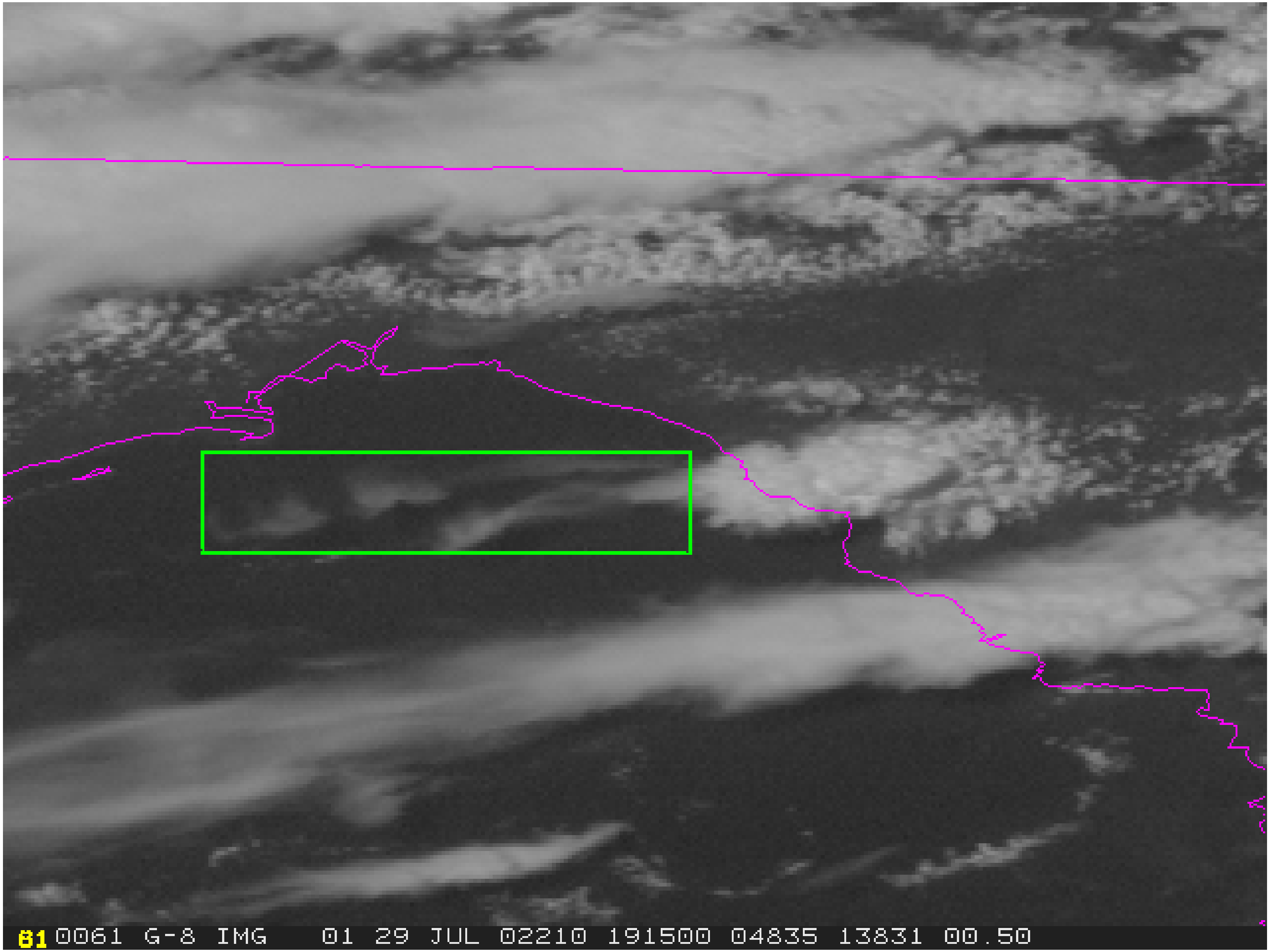
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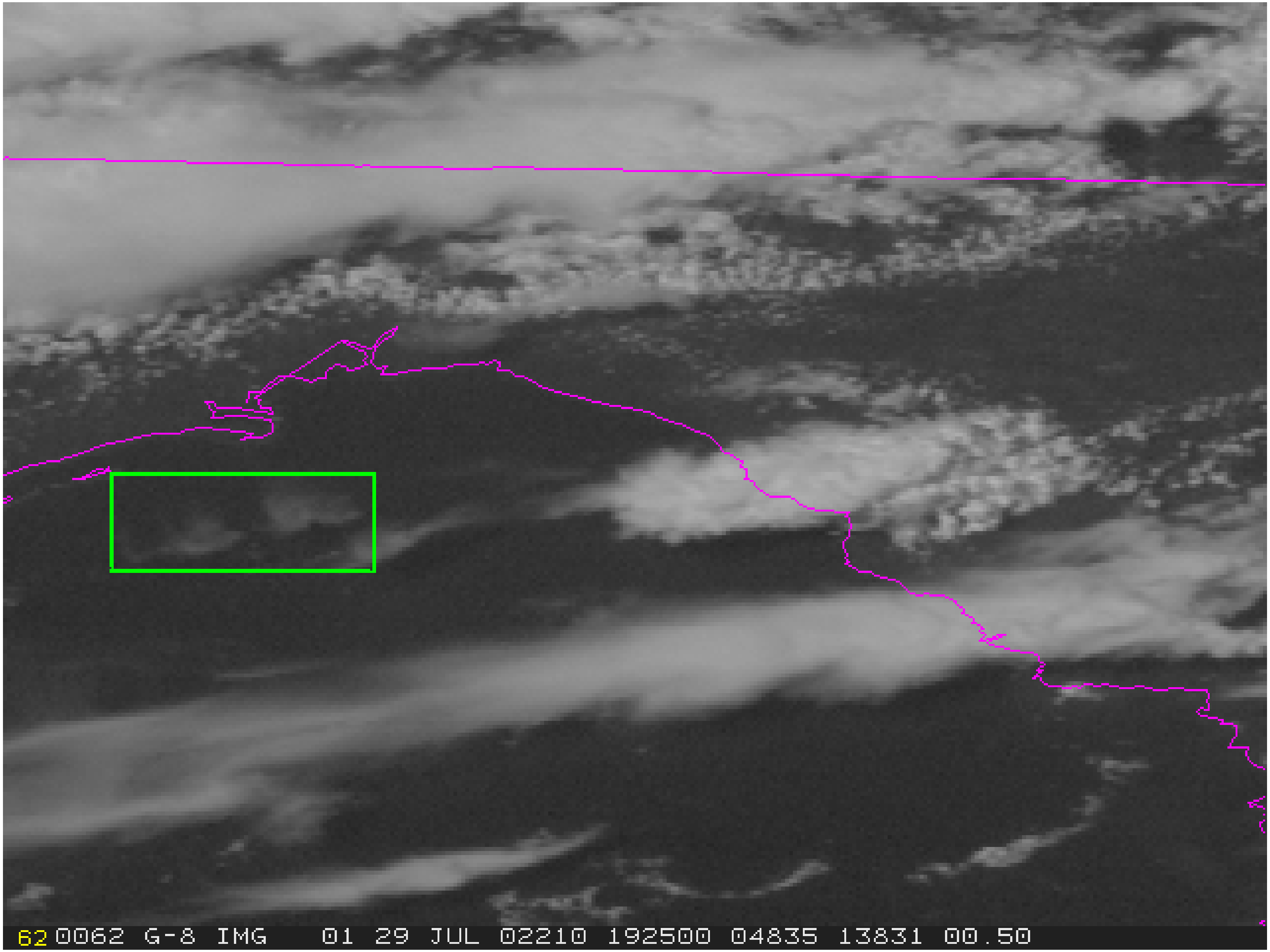
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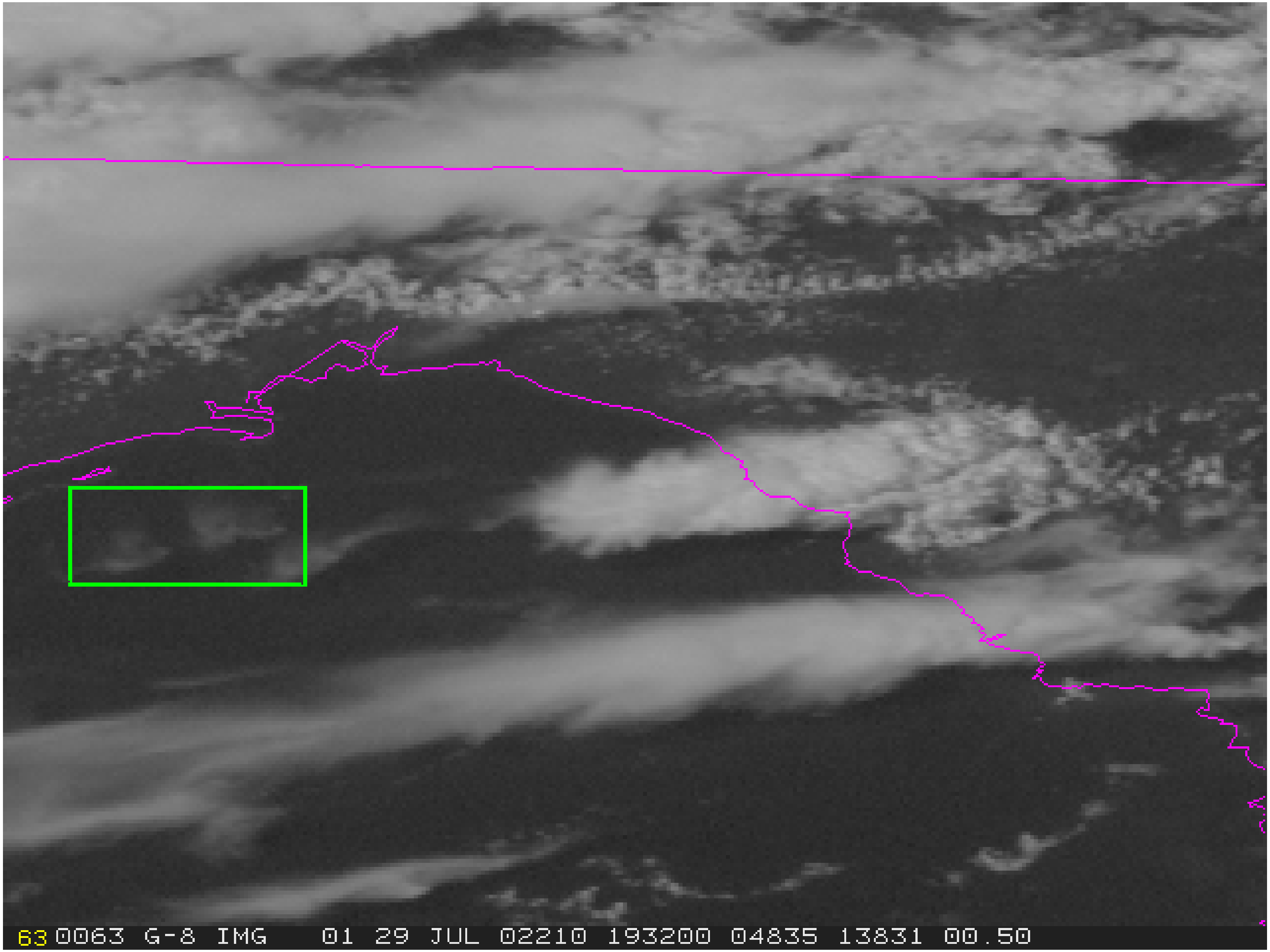
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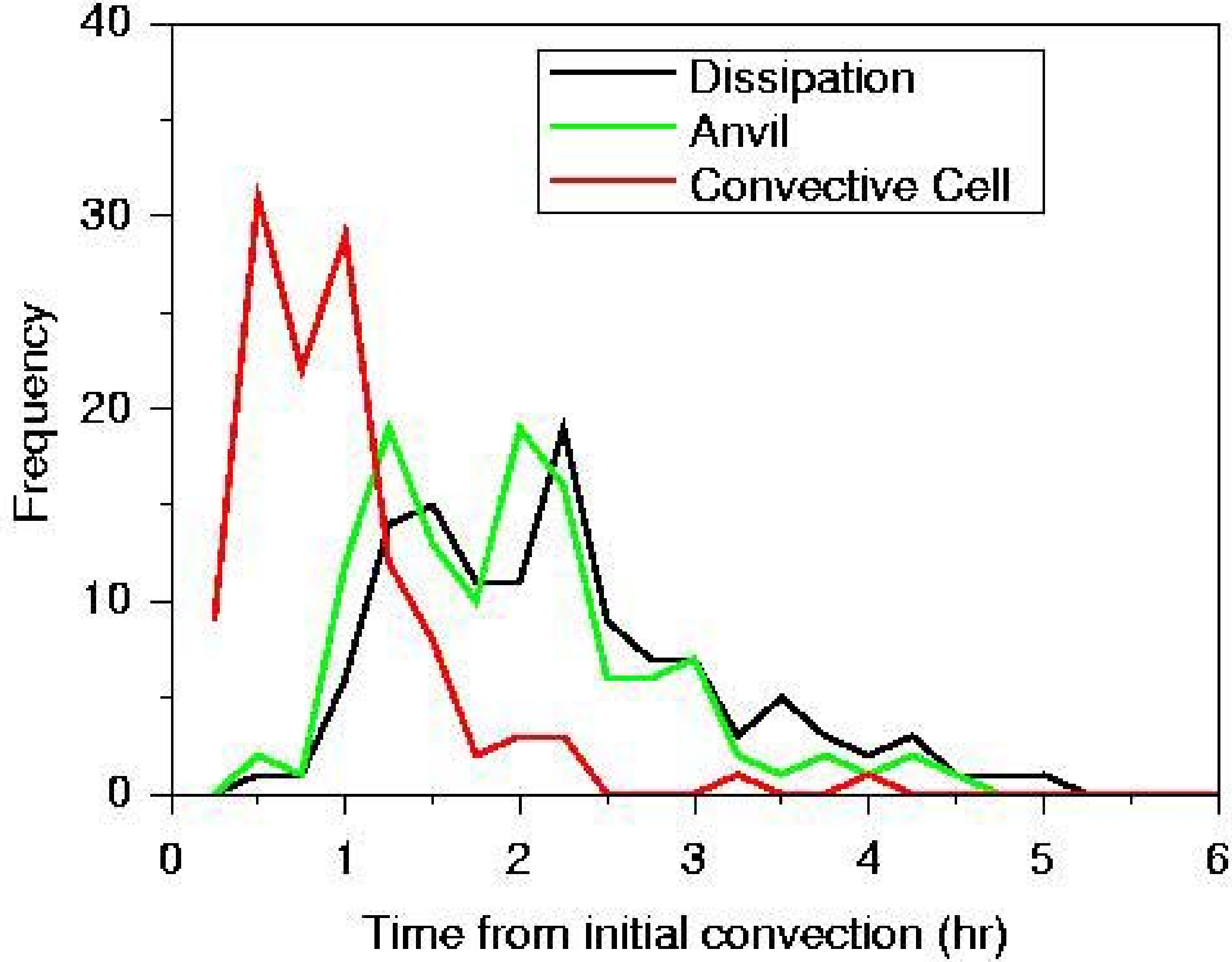
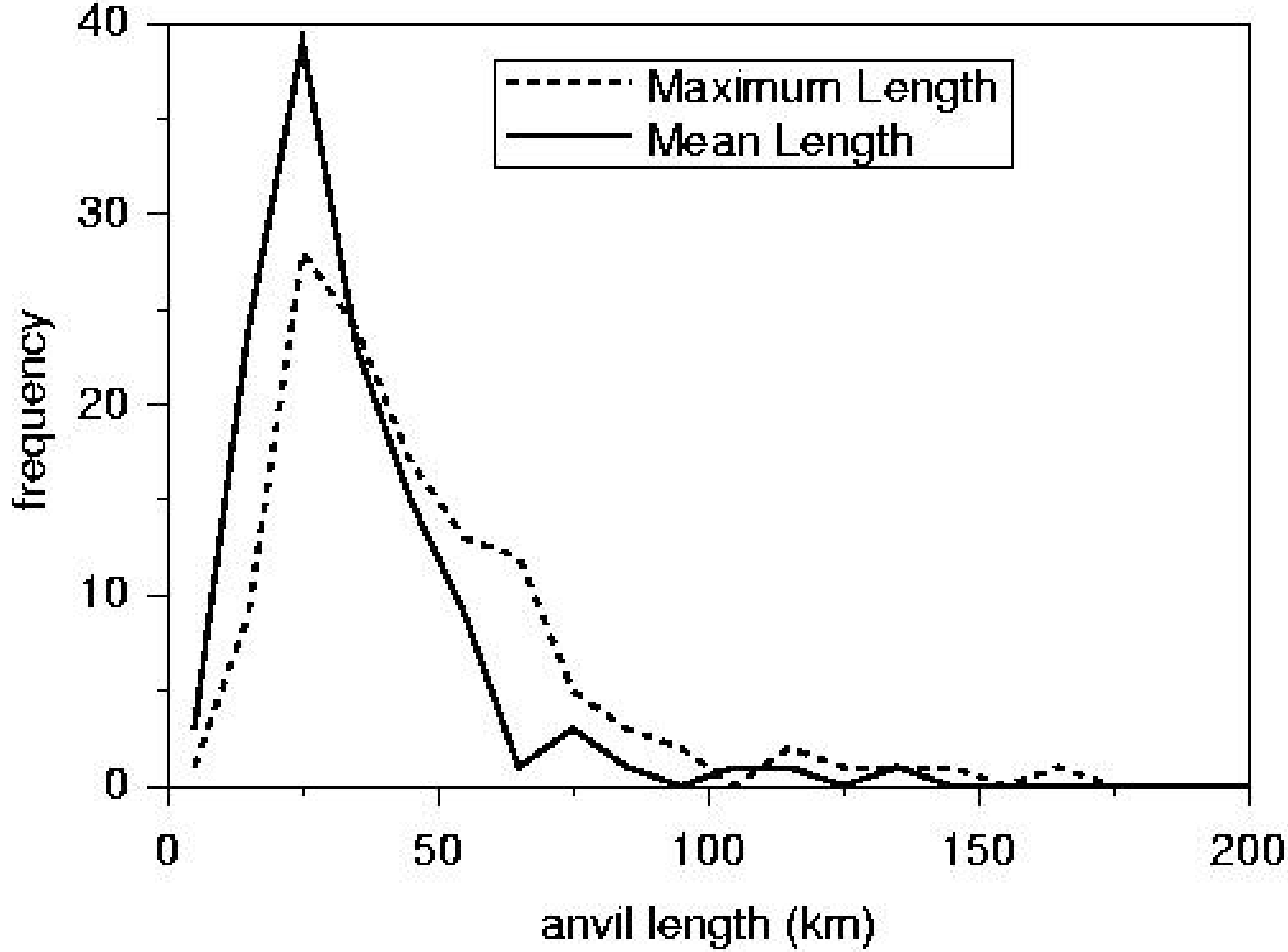
DURATION HISTOGRAM

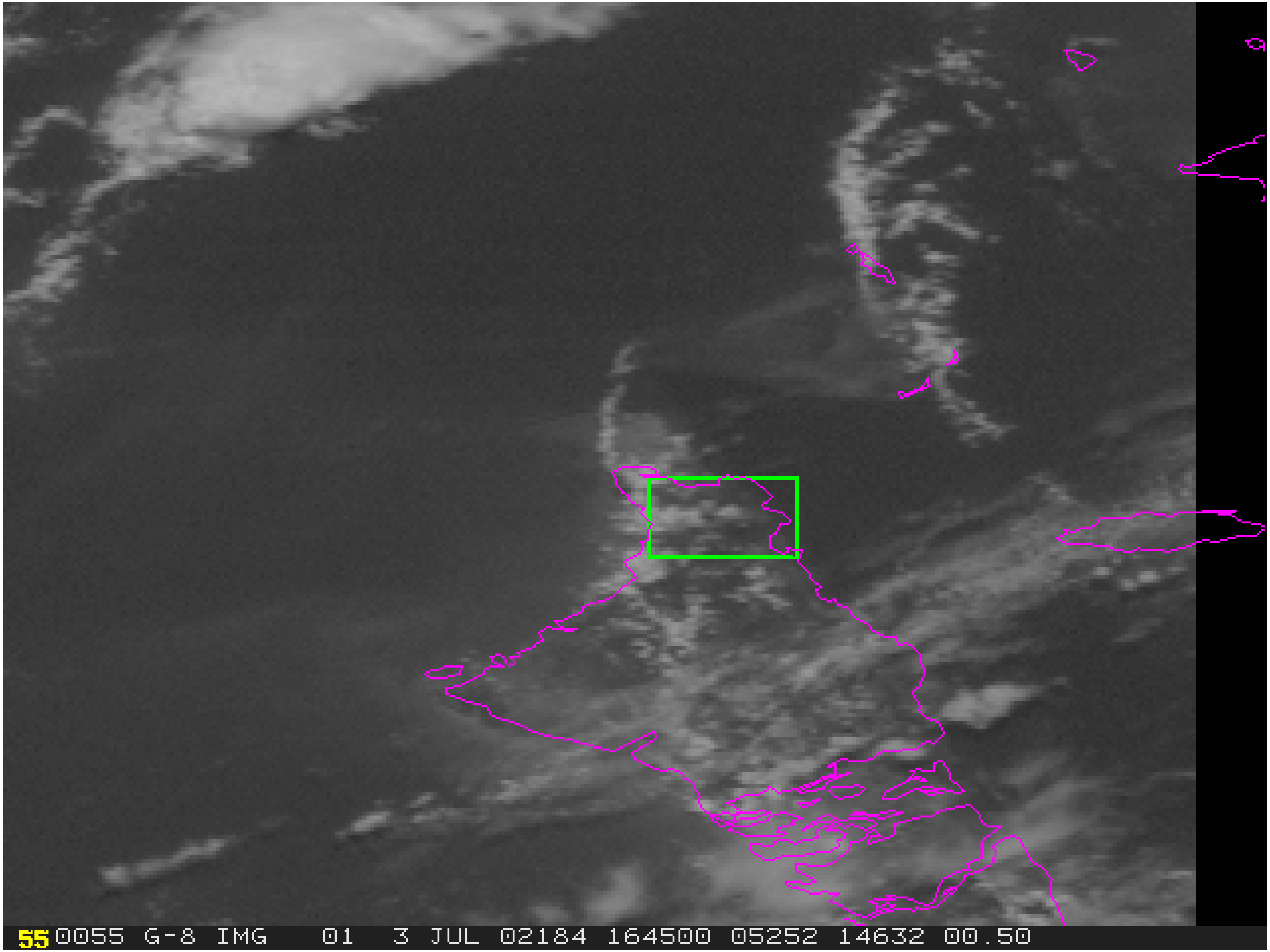


ANVIL LENGTH HISTOGRAM



Andros Island Anvil Movie

- GOES-8 1-km 15 minute visible images
- July 3,2002 (16:45-19:15 GMT)
- Note the break-up of the anvil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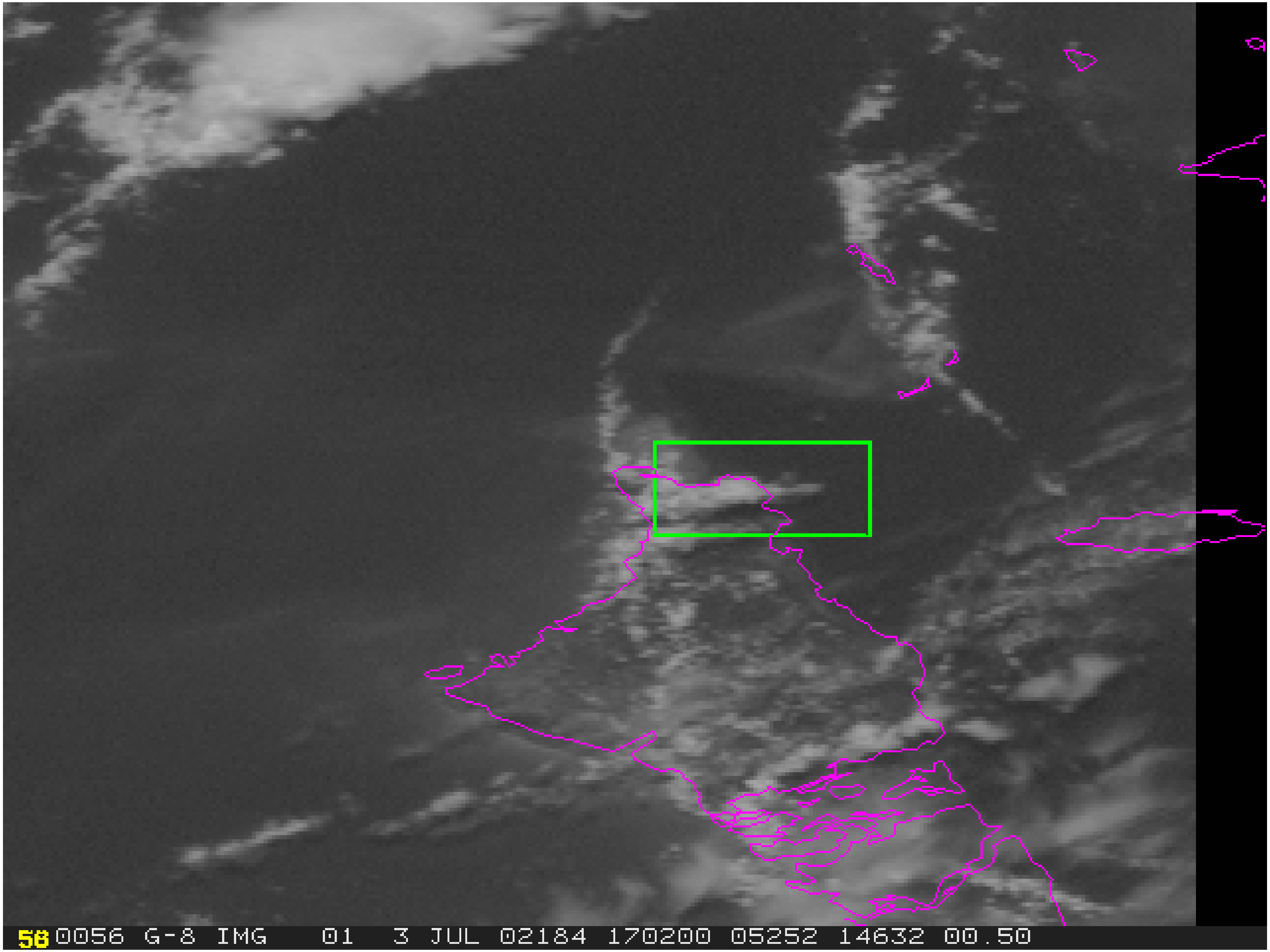
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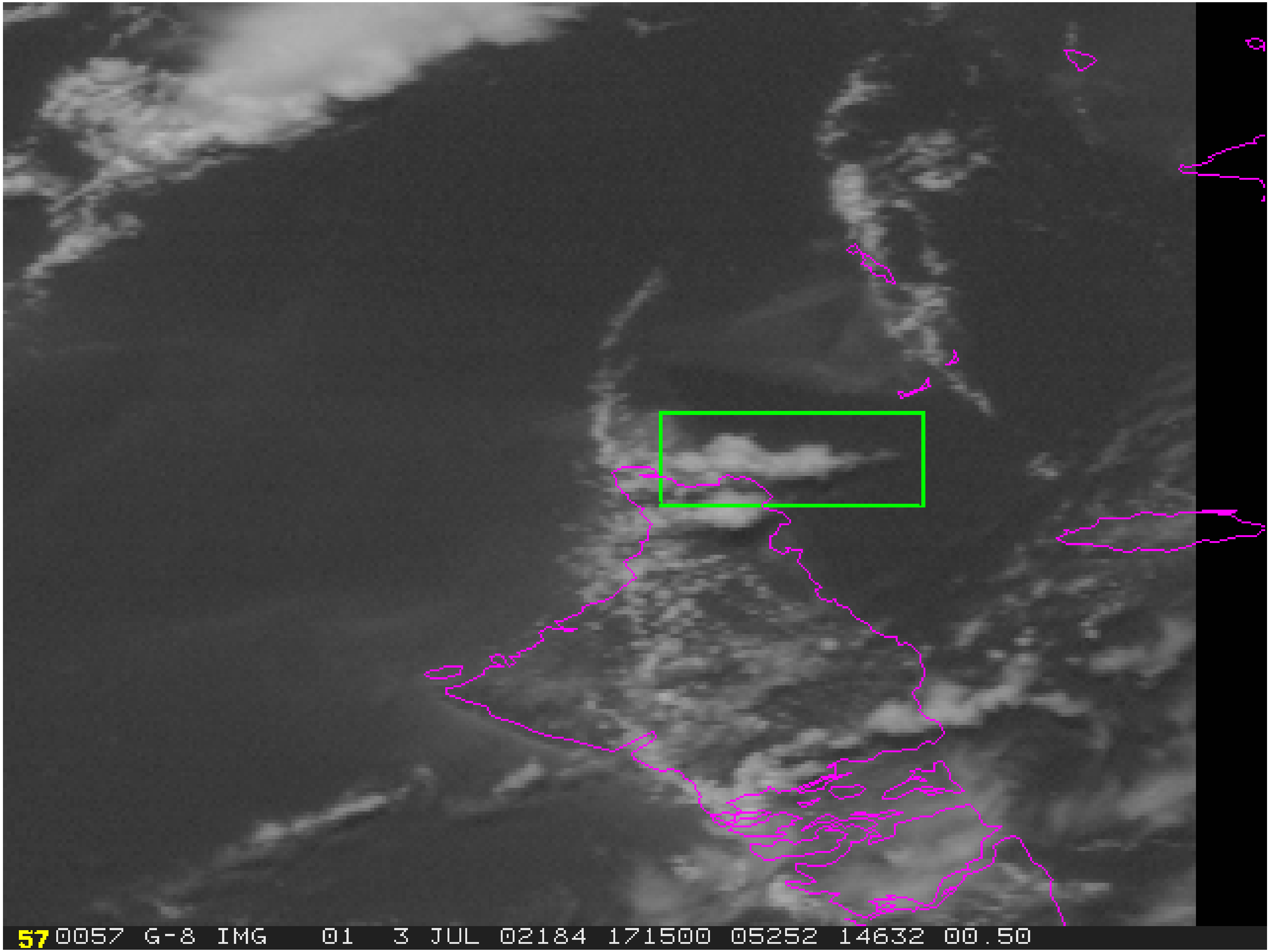
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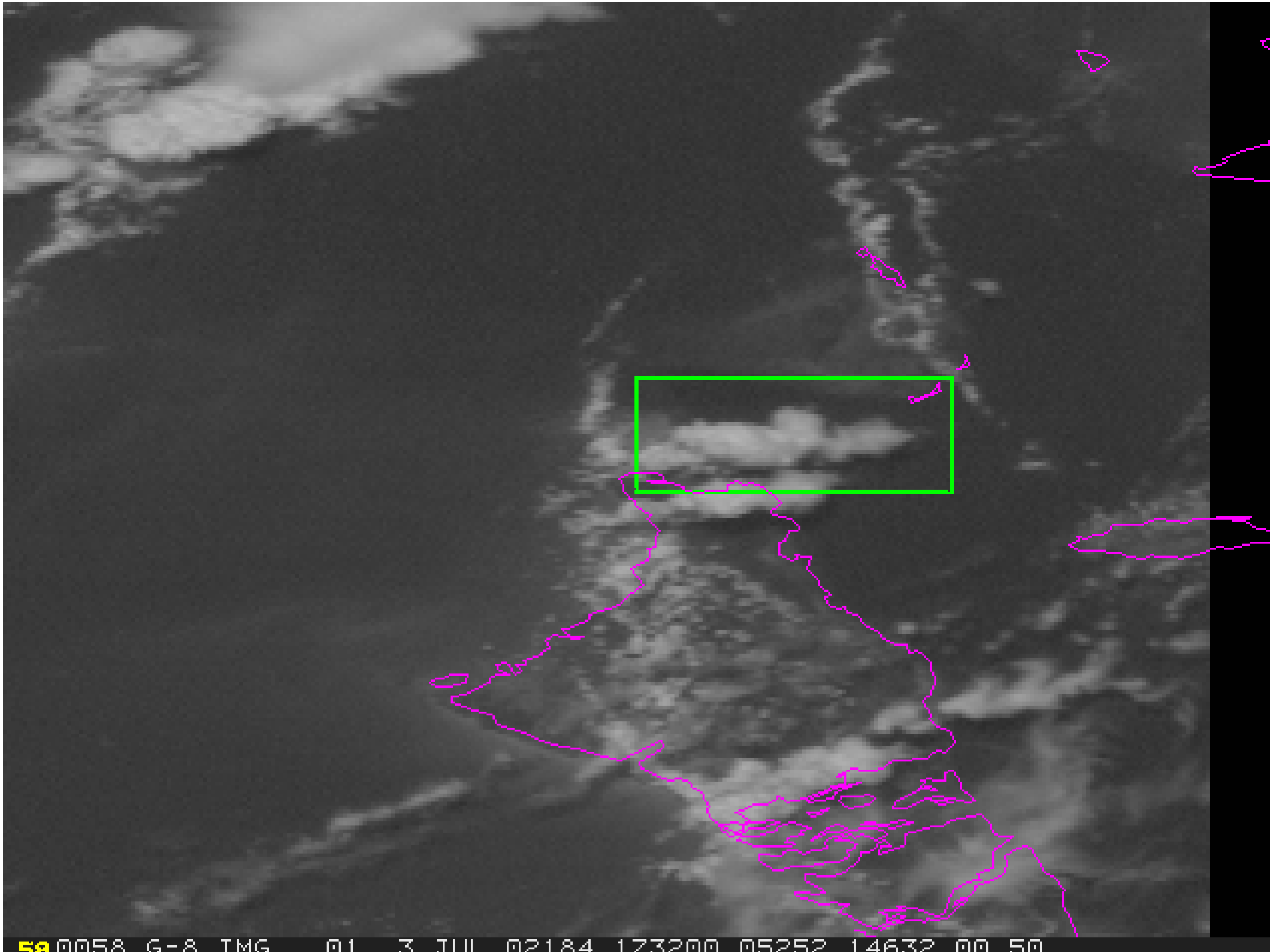
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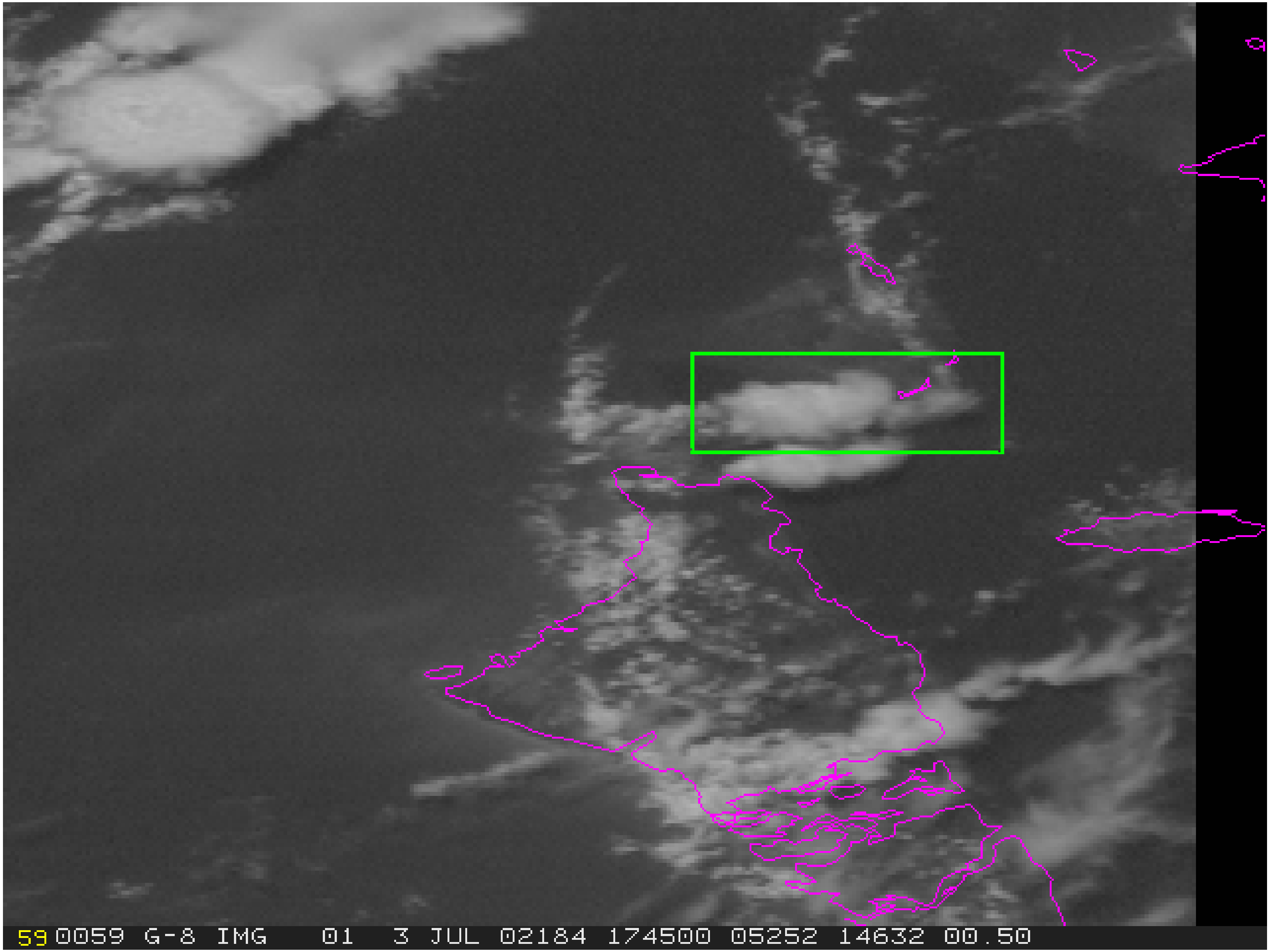
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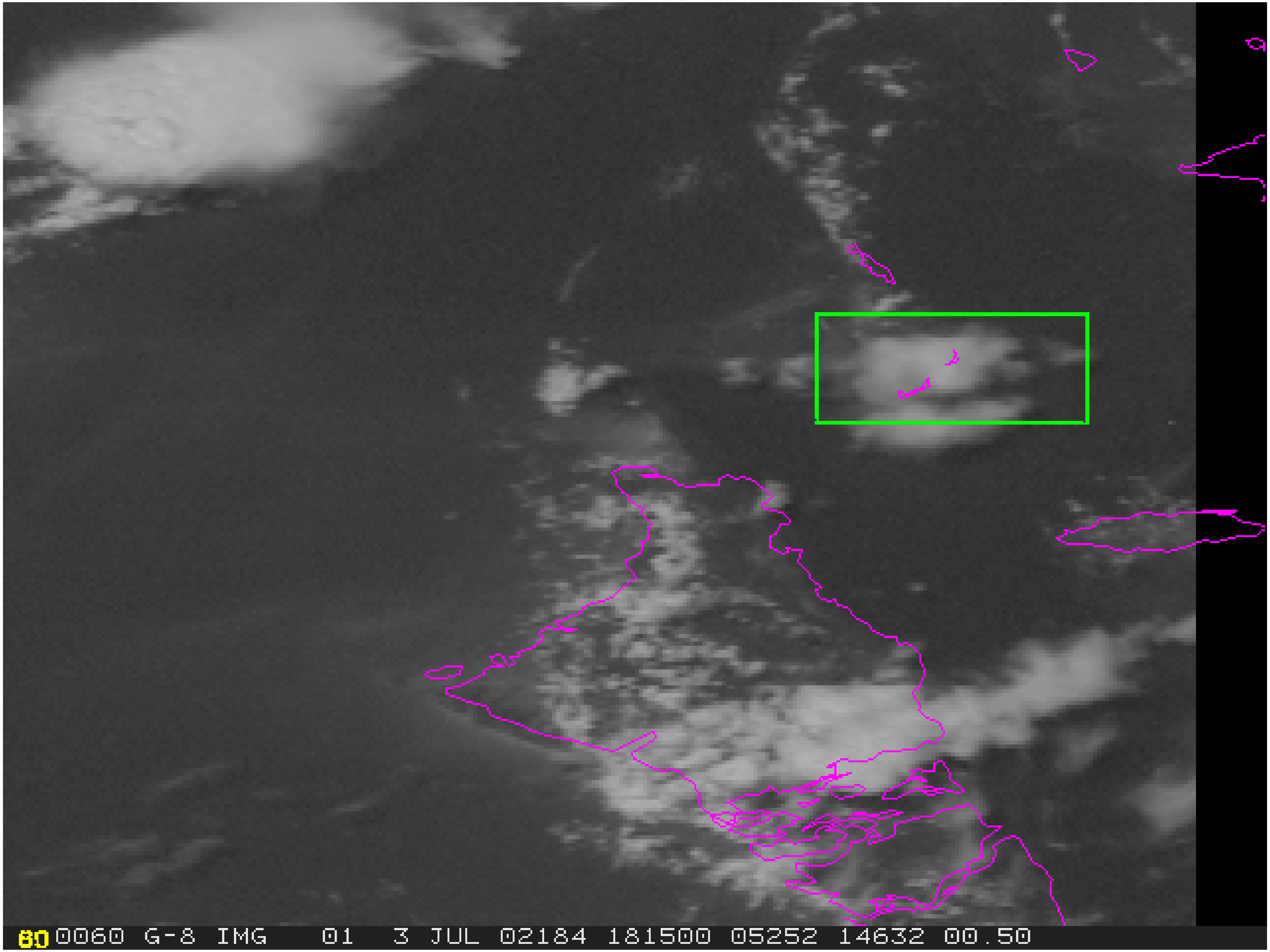
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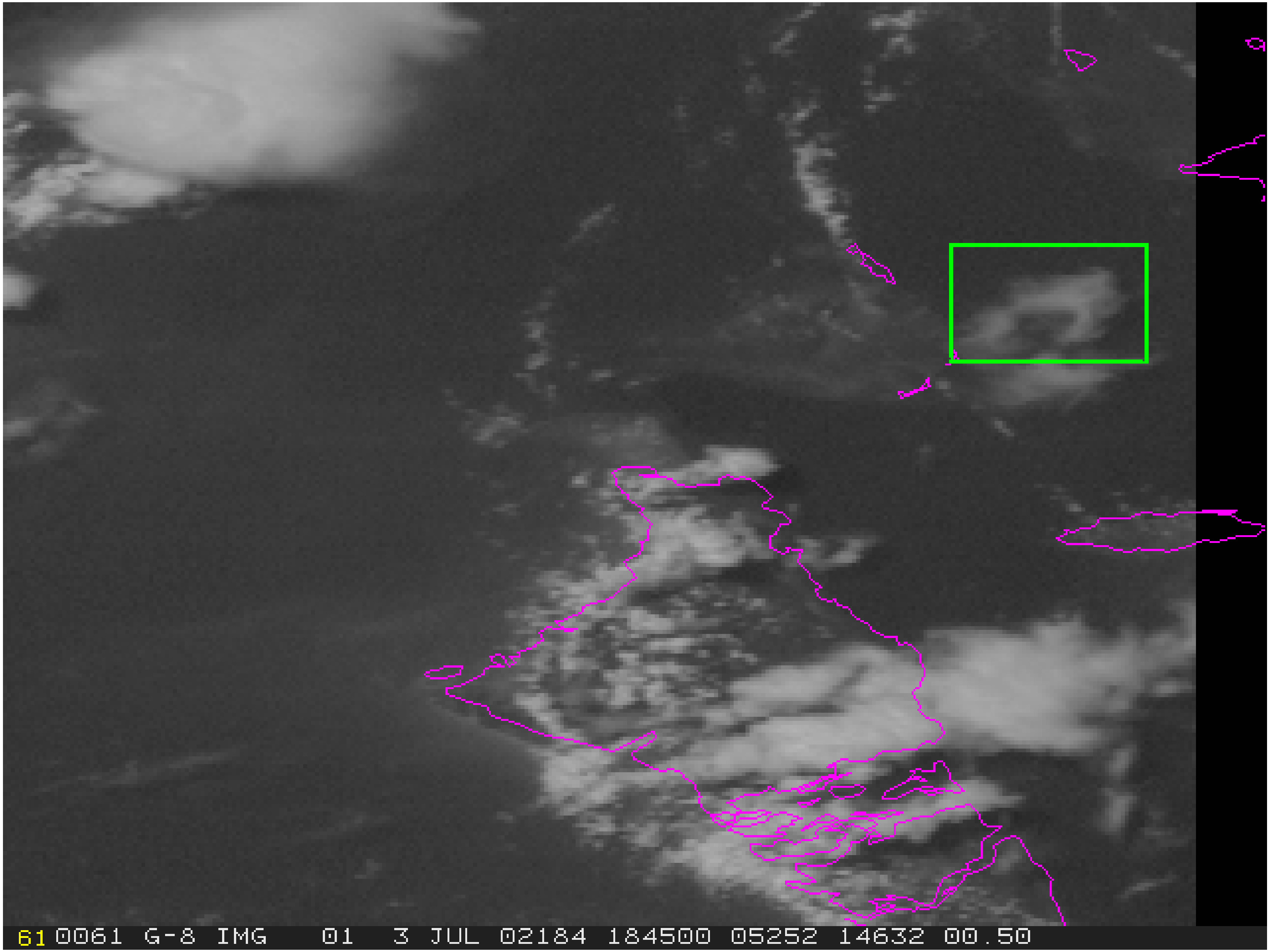
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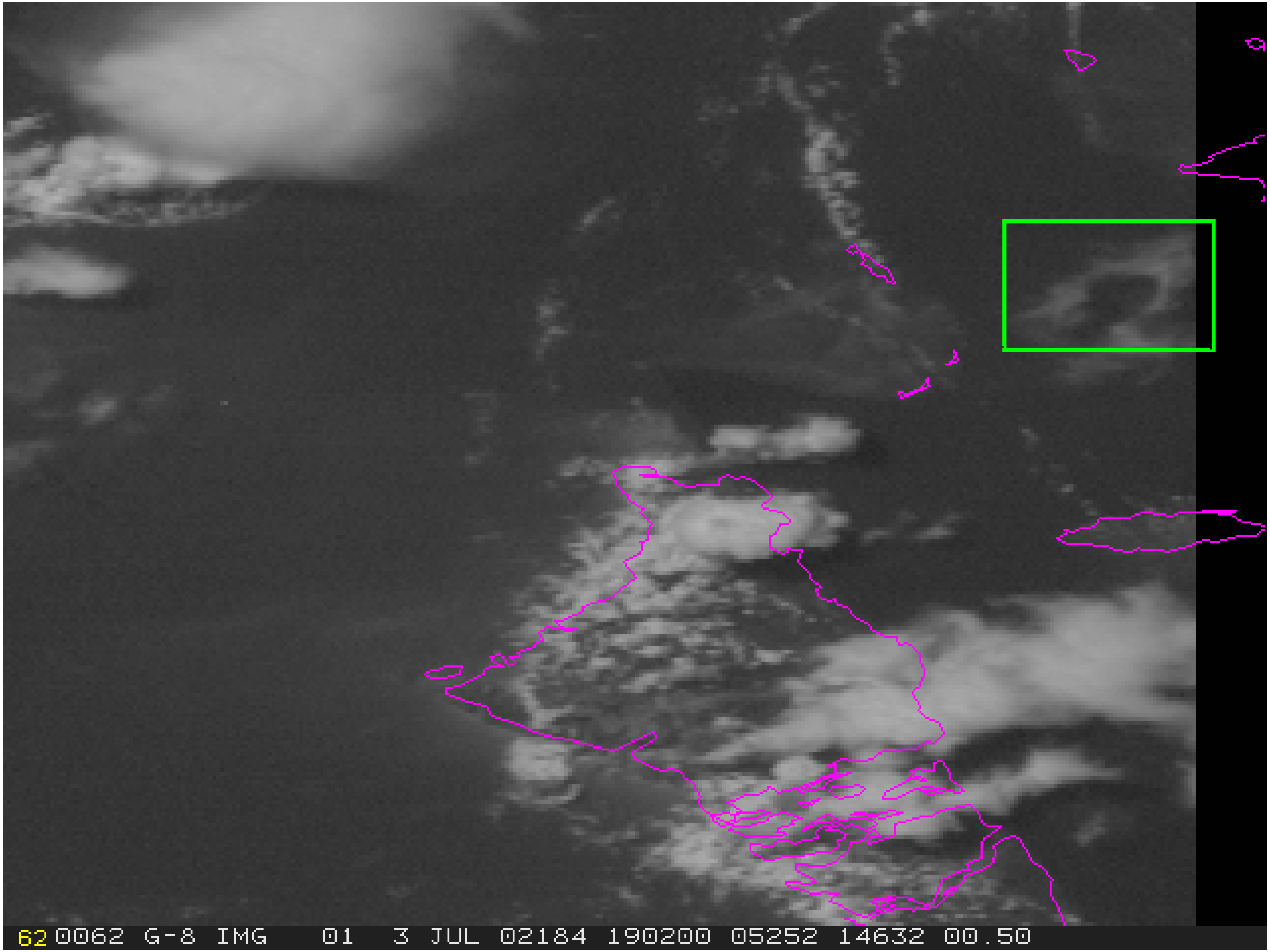
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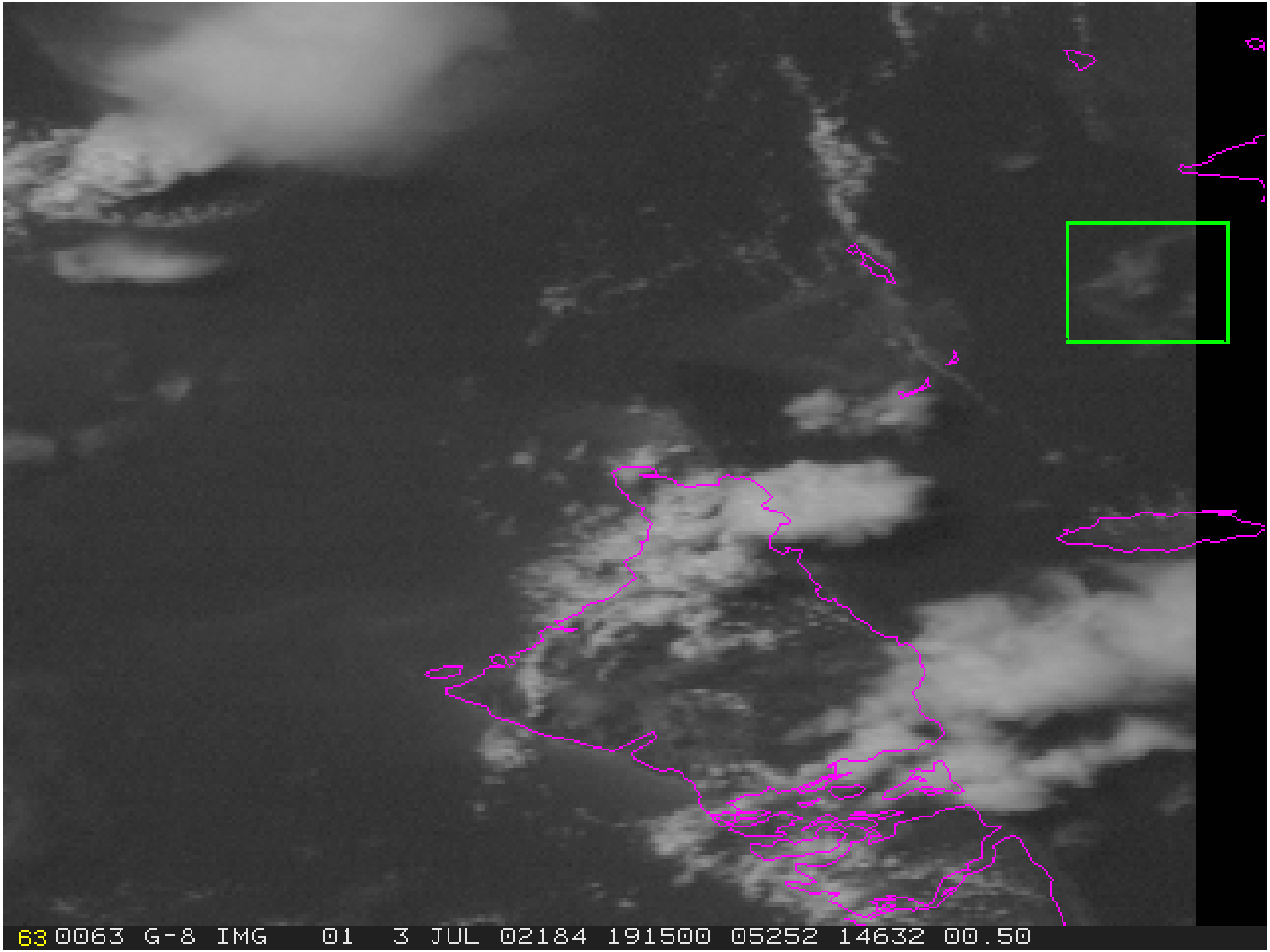

63 0063 G-8 IMG 01 3 JUL 02184 191500 05252 14632 00.50

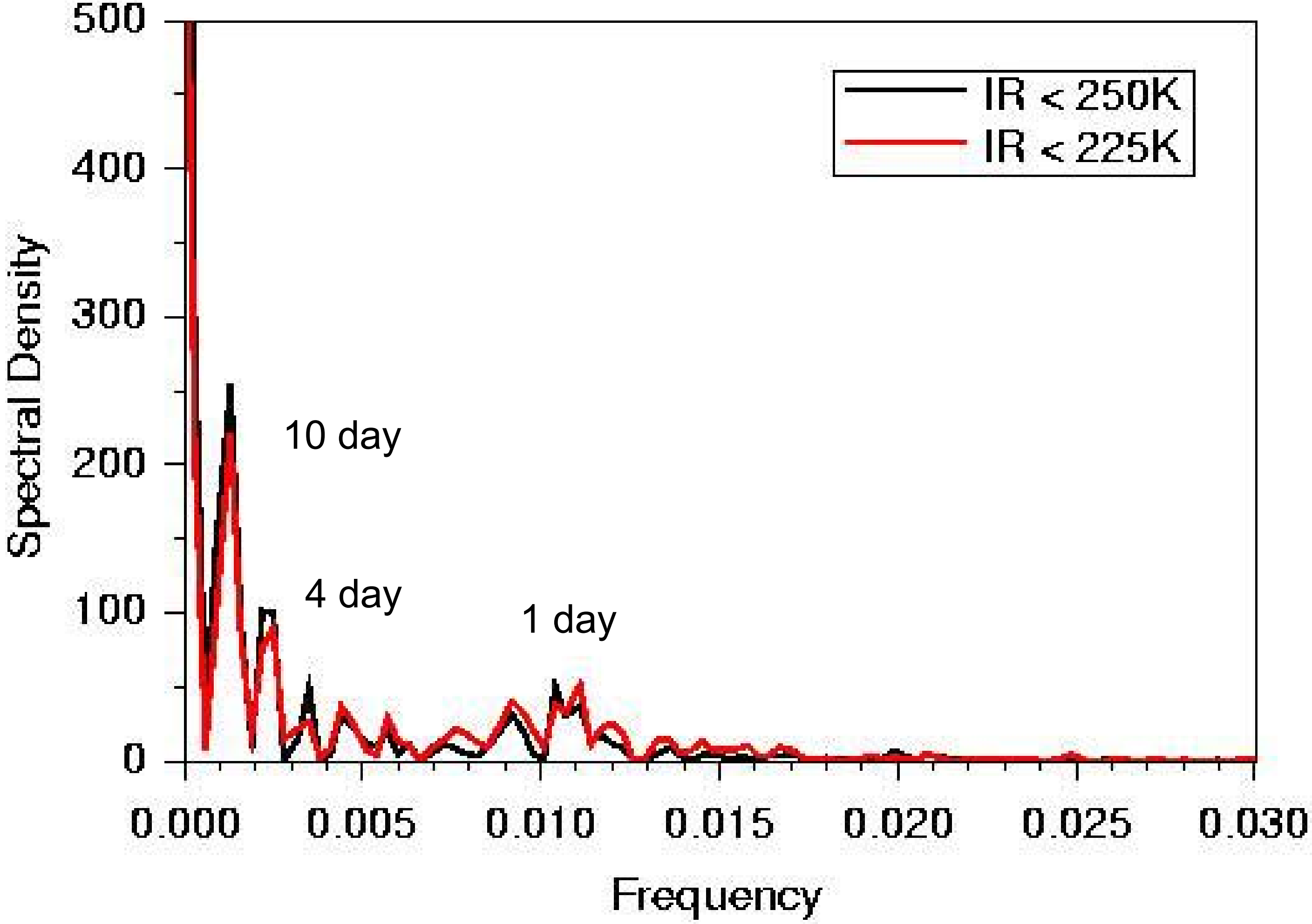
Future

- Incorporate night time cloud products to complete diurnal cycles
- Examine thin cirrus heights. Why they are lower than thick cirrus
- Improve anvil tracking
  - Use IR temperatures to isolate convective cells
  - Investigate multiple cell anvil systems
  - Use night time data
  - Use VISST cloud products to determine convective and anvil spatial boundaries and tracking
- Correlate anvil properties with model parameters
  - upper level humidity and winds
  - convective strength indicators, CAPE

Future

- Determine cirrus sources for a region
  - Convective
  - Dissipation
  - Advective

BAHAMAS



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Spectral Density
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10 day
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0.000
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0.020
0.025
0.030
Frequency